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June 25, 2008

Ms. Vickie L. Prather, Acting Supervisor
Division of Water
KPDES Branch
Inventory & Data Management Section
Frankfort Office Park
14 Reilly Road
Frankfort, Kentucky 40601

RE: Renewal Application, KPDES Permit No. KY0103888

Dear Ms. Prather:

On behalf of Cal-Maine Foods, Inc., EnSafe has prepared the enclosed Kentucky Pollutant Discharge Elimination System (KPDES) permit renewal application for KPDES Permit No. KY0103888 issued to the Cal-Maine Foods facility located at 9729 Guthrie Road, Guthrie, Todd County, Kentucky. This facility's existing KPDES permit expires on January 31, 2009. A permit renewal fee of $1,200 is also enclosed.

Cal-Maine and EnSafe look forward to renewal of this permit and appreciate your attention to this matter. If you have any questions, please call me at (list the Nashville number here) or Helen Brady at (580) 716-4313.

Sincerely,

EnSafe Inc.

David Hutson

By: David Hutson

cc: Marc Ashby, Cal-Maine Foods, Inc.

Enclosures

KPDES PERMIT RENEWAL APPLICATION
FOR A
CONCENTRATED ANIMAL FEEDING OPERATION

KPDES PERMIT NO. KY0103888

CAL-MAINE FOODS, INC.
9729 GUTHRIE ROAD
GUTHRIE, KENTUCKY

EnSafe Project Number
0888804595

Prepared for:

Cal-Maine Foods, Inc.
3320 West Woodrow Wilson Avenue
Jackson, Mississippi 39207

Prepared by:

EnSafe Inc.
5724 Summer Trees Drive
Memphis, Tennessee 38134
(901) 372-7962
(800) 588-7962
www.ensafe.com

June 25, 2008

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KPDES FORM 1

4304

KENTUCKY POLLUTANT DISCHARGE ELIMINATION SYSTEM

RECEIVED
JUN 30 2008
By

PERMIT APPLICATION

This is an application to: (check one)
- ☐ Apply for a new permit.
- ☒ Apply for reissuance of expiring permit.
- ☐ Apply for a construction permit.
- ☐ Modify an existing permit.
  Give reason for modification under Item II.A.

A complete application consists of this form and one of the following:
Form A, Form B, Form C, Form F, or Form SC

$1200.00 ck.

For additional information contact:
KPDES Branch (502) 564-3410

I. FACILITY LOCATION AND CONTACT INFORMATION	AGENCY USE: 0 1 1 0 3 8 8 8
A. Name of business, municipality, company, etc. requesting permit Cal-Maine Foods, Inc.	
B. Facility Name and Location	C. Primary Mailing Address (all facility correspondence will be sent to this address). **Include owner mailing address on a separate sheet if different.**
Facility Location Name: Cal-Maine Foods, Inc.	Facility Contact Name and Title: Mr. ☒ Ms. ☐ Marc Ashby, General Manager
Facility Location Address (i.e. street, road, etc., **not PO Box**): 9729 Guthrie Road (Highway 181)	Mailing Address: 9729 Guthrie Road (Highway 181)
Facility Location City, State, Zip Code: Guthrie, Kentucky 42234	Mailing City, State, Zip Code: Guthrie, Kentucky 42234
	Facility Contact Telephone Number: 270-483-2002

II. FACILITY DESCRIPTION			
A. Provide a brief description of activities, products, etc: This facility is a layer farm engaged in the production, grading, packing, and sale of fresh chicken eggs See Attachment to Form 1 for more information.			
B. Standard Industrial Classification (SIC) Code and Description			
Principal SIC Code & Description:	0252 Production of Chicken Eggs		
Other SIC Codes:	Not applicable.		

III. FACILITY LOCATION	
A. Attach a U.S. Geological Survey 7 ½ minute quadrangle map for the site. (See instructions)	
B. County where facility is located: Todd County	City where facility is located (if applicable): Not Applicable
C. Body of water receiving discharge: Unnamed tributary of Spring Creek	
D. Facility Site Latitude (degrees, minutes, seconds): 36° 40' 35"	Facility Site Longitude (degrees, minutes, seconds): 87° 12' 19"
. Method used to obtain latitude & longitude (see instructions):	Topographic Map Coordinates
F. Facility Dun and Bradstreet Number (DUNS #) (if applicable):	Not applicable

IV. OWNER/OPERATOR INFORMATION

A. Type of Ownership:

☐ Publicly Owned ☒ Privately Owned ☐ State Owned ☐ Both Public and Private Owned ☐ Federally owned

B. Operator Contact Information (See instructions)

Name of Treatment Plant Operator: Cal-Maine Foods with the part-time assistance of Gary Russ of Russ and Associates	Telephone Number: Cal-Maine Foods: 270-483-2002 Russ and Associates: 270-754-3359
Operator Mailing Address (Street): Cal-Maine Foods, Inc., 9729 Guthrie Road	
Operator Mailing Address (City, State, Zip Code): Guthrie, Kentucky 42234	
Is the operator also the owner? Yes ☒ No ☐	Is the operator certified? If yes, list certification class and number below. Yes ☐ No ☒
Certification Class: Gary Russ of Russ and Associates: Class III Wastewater	Certification Number: #06462

V. EXISTING ENVIRONMENTAL PERMITS

Current NPDES Number: KPDES No. KY0103888	Issue Date of Current Permit: January 31, 2004	Expiration Date of Current Permit: January 31, 2009
Number of Times Permit Reissued: One	Date of Original Permit Issuance: October 13, 2000	Sludge Disposal Permit Number: Not applicable
Kentucky DOW Operational Permit #: Not Applicable	Kentucky DSMRE Permit Number(s): Not applicable	

Which of the following additional environmental permit/registration categories will also apply to this facility?

CATEGORY	EXISTING PERMIT WITH NO.	PERMIT NEEDED WITH PLANNED APPLICATION DATE
Air Emission Source	Not Applicable	
Solid or Special Waste	Not Applicable	
Hazardous Waste - Registration or Permit	Not Applicable	

VI. DISCHARGE MONITORING REPORTS (DMRs)

KPDES permit holders are required to submit DMRs to the Division of Water on a regular schedule (as defined by the KPDES permit). Information in this section serves to specifically identify the name and telephone number of the DMR official and the DMR mailing address (if different from the primary mailing address in Section I.C).

A. DMR Official (i.e., the department, office or individual designated as responsible for submitting DMR forms to the Division of Water):	Marc Ashby, General Manager (if DMRs are ever required) NOTE: THIS IS A NO DISCHARGE FACILITY. NO DMRS HAVE BEEN REQUIRED.
DMR Official Telephone Number:	270-483-2002

B. DMR Mailing Address:

- Address the Division of Water will use to mail DMR forms (if different from mailing address in Section I.C), or
- Contact address if another individual, company, laboratory, etc. completes DMRs for you; e.g., contract laboratory address.

DMR Mailing Name:	Cal-Maine Foods, Inc.
DMR Mailing Address:	9729 Guthrie Road
DMR Mailing City, State, Zip Code:	Guthrie, Kentucky 42232

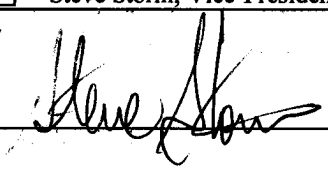
VII. APPLICATION FILING FEE

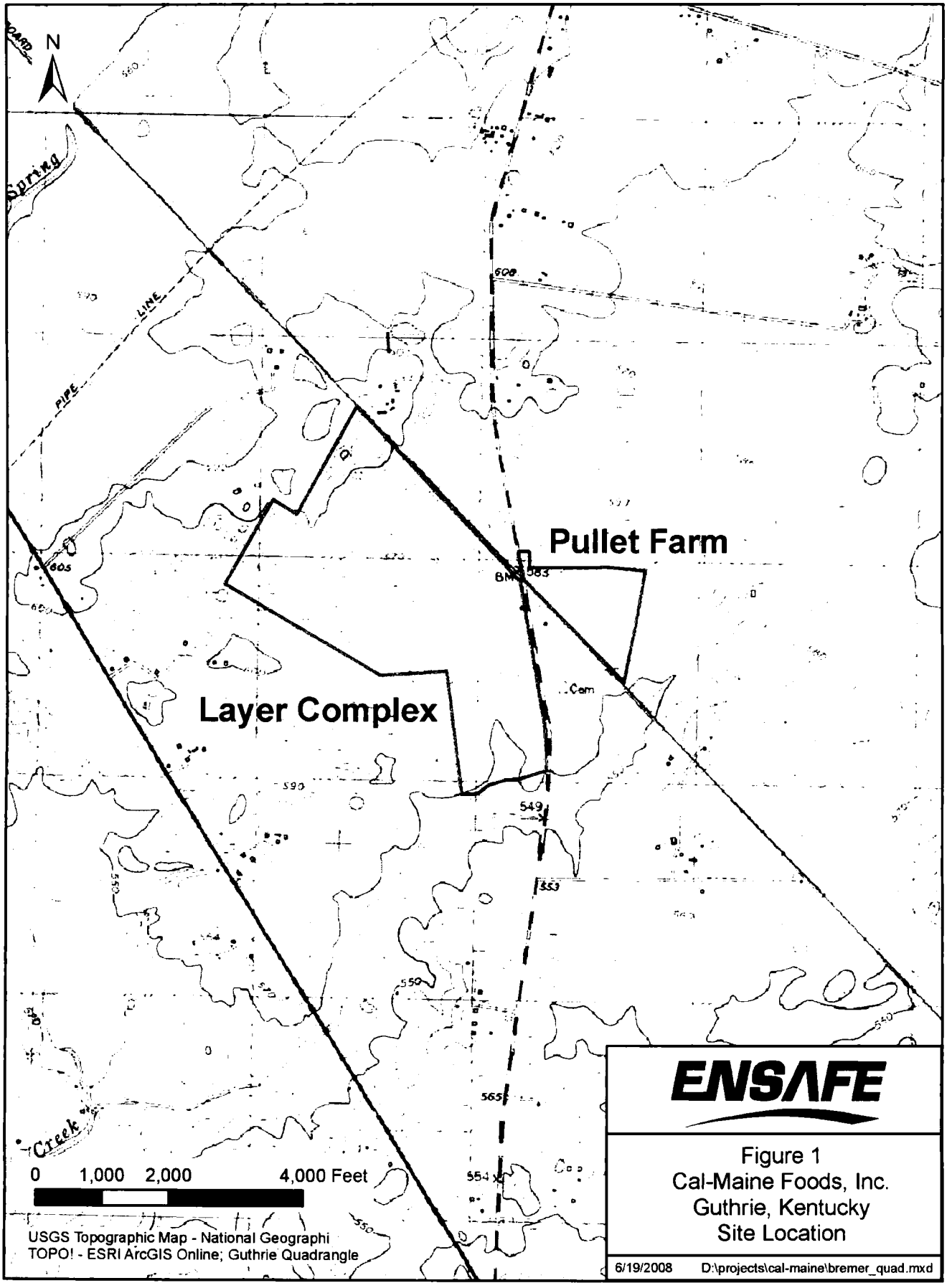
KPDES regulations require that a permit applicant pay an application filing fee equal to twenty percent of the permit base fee. Please examine the base and filing fees listed below and in the Form 1 instructions and enclose a check payable to "Kentucky State Treasurer" for the appropriate amount (for permit renewals, please include the KPDES permit number on the check to ensure proper crediting). Descriptions of the base fee amounts are given in the "General Instructions."

Facility Fee Category:	Filing Fee Enclosed:
Agriculture	$1,200.00

VIII. CERTIFICATION

I certify under penalty of law that this document and all attachments were prepared under my direction or supervision in accordance with a system designed to assure that qualified personnel properly gather and evaluate the information submitted. Based on my inquiry of the person or persons who manage the system, or those persons directly responsible for gathering the information, the information submitted is, to the best of my knowledge and belief, true, accurate, and complete. I am aware that there are significant penalties for submitting false information, including the possibility of fine and imprisonment for knowing violations.

NAME AND OFFICIAL TITLE (type or print):	TELEPHONE NUMBER (area code and number):
Mr. ☒ Ms. ☐ Steve Storm, Vice-President	601-948-6813
SIGNATURE 	DATE 6/26/08


N
Spring
LINE
PIPE
Pullet Farm
Layer Complex
Creek
0 1,000 2,000 4,000 Feet
USGS Topographic Map - National Geographi
TOPO! - ESRI ArcGIS Online; Guthrie Quadrangle
ENSAFE
Figure 1
Cal-Maine Foods, Inc.
Guthrie, Kentucky
Site Location
6/19/2008 D:\projects\cal-maine\bremer_quad.mxd

ADDITIONAL INFORMATION
KPDES FORM 1

I. FACILITY OWNER/ MAILING ADDRESS

Cal-Maine Foods, Inc.
3320 Woodrow Wilson Drive
Jackson, Mississippi 39209
601-948-6813

II.A. FACILITY DESCRIPTION

The Cal-Maine Foods, Inc., facility at 9729 Guthrie Road (Highway 181) in Guthrie, Todd County, Kentucky, is primarily engaged in the production of chicken eggs. The facility operations are conducted on two parcels of land:

1. Two Layer Complexes are on the Layer Farm, an approximately 290-acre parcel of land used for production and packaging of eggs. The Layer Farm is comprised of 23 layer houses, two egg processing facilities, a wastewater lagoon, and an egg processing wastewater treatment system. Offices, two emergency generator buildings, and a truck maintenance shop are also on the Layer Farm property. Other portions of the property are used as farmland.

2. The 40-acre Pullet Farm is east of the Layer Farm. On this parcel, pullets are raised until old enough to be transferred to the Layer Complex for egg production. The Pullet Farm is comprised of five pullet houses and a storage/generator building.

IV. WASTEWATER TREATMENT

Approximately 1,500,000 eggs are processed at the Layer Farm each day. Process wastewater generated in the eastern egg processing facility is treated in an onsite package treatment plant. Process wastewater generated in the western egg processing facility is treated in a naturally aerated lagoon. Domestic wastewater from both egg processing facilities is treated in the package treatment plant.

Approximately 4,500 gallons of wastewater are treated in the package treatment plant each day, which is well below the design capacity the plant of 7,500 gallons per day (gpd). The 4,500 gpd is comprised of approximately 2,000 gallons of egg processing wastewater from the eastern Layer Complex, and 2,500 gallons of domestic sewage from both Layer Complexes.

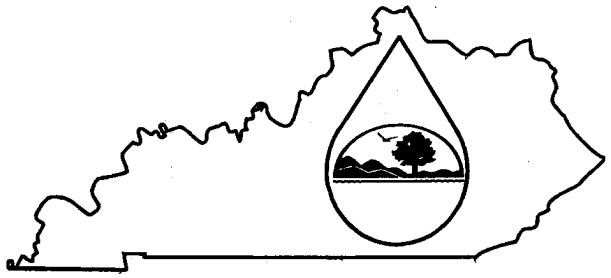
The package treatment plant, Model SC-26K, was manufactured by Santec Corporation of Aurora, Colorado, and installed at the Cal-Maine facility in November 1991. It is an extended aeration plant with activated sludge. Wastewater flows through an eggshell strainer basket (also called a solids intercept basket), then into three complete-mix flow-through reactors in series, in which removal of organic waste takes place. The water then flows into reactor 4 which has a gentle aeration section and a clarifier.

Sludge from reactor 4 can be directed back into reactor 3 or wasted to a 5,000-gallon sludge holding tank. The sludge from the holding tank is dried on an onsite sludge drying bed and then removed by an outside contractor as a solid waste. Effluent from reactor 4 is directed into a 10,000-gallon holding tank for storage until land application by spray irrigation. The effluent is either spray irrigated on a field to the south of the wastewater treatment plant or directed into the wastewater lagoon for land application on the lagoon irrigation fields, according to nutrient balance needs in the irrigation fields.

The wastewater lagoon was constructed in 2002 on the west side of the Layer Farm. The lagoon location complies with the separation distances recommended by the Natural Resource Conservation Service Conservation Practice Standard for Waste Treatment Lagoons, Code 359. The rectangular lagoon surface area is approximately 75,000 square feet, based on lagoon dimensions of 250 feet by 300 feet. The lagoon receives approximately 3,500 gpd of egg processing wastewater from the western Layer Complex. In addition, treatment plant effluent is occasionally directed into the lagoon prior to onsite land application, in amounts ranging from 1,500 to 4,500 gpd. Lagoon wastewater that is not depleted by evaporation is spray irrigated onto Cal-Maine cropland. The irrigation rate is controlled so as to prevent effluent from running offsite. Lagoon sludge will be removed as necessary (estimated frequency is once per 10 years) and disposed offsite as a solid waste.

The treatment plant and lagoon are operated by Cal-Maine with the part-time assistance of an outside consultant, Gary Russ of Russ and Associates. Mr. Russ is certified as a Class III Wastewater Operator, #06462, and is available to provide technical assistance to Cal-Maine in the operation of the wastewater treatment plant and lagoon, as needed. Russ and Associates is located at 80 Parkway Lane, Central City, Kentucky 42330, (270) 754-3359.

KPDES FORM B



Kentucky Pollutant Discharge Elimination System

Permit Application

Animal Waste Management

A complete application consists of this form and Form 1.
For additional information, contact: KPDES Branch, (502) 564-3410.

Name of Facility Cal-Maine Foods, Inc.

I. GENERAL INFORMATION (See Instructions)	Agency Use							

A. Type of business (Check one)

☒ Concentrated animal feeding operation (Complete Items I and II)

☐ Concentrated aquatic animal production operation (Complete Items I and III)

B. Give a legal description of the facility location.

This facility is comprised of two parcels of land. The westernmost parcel contains the Layer Complexes, and the easternmost parcel contains the Pullet Farm. A legal description of each parcel is attached.

C. Facility operation status (Check one)

☒ Existing facility

☐ Proposed facility

II. CONCENTRATED ANIMAL FEEDING OPERATION CHARACTERISTICS

A. Type and number of animals in open and housed.

Type	Number in Open Confinement	Number Housed Under Roof
Layer Hens	None	2,800,000
Pullets	None	530,000

B. Number of acres for confinement feeding N/A acres.

Number of acres for land application of waste 180 acres.

II. CONCENTRATED ANIMAL FEEDING OPERATION CHARACTERISTICS (continued)

C. If there is open confinement, has a runoff diversion and control system been constructed?

☐ Yes (Complete 1, 2, & 3) ☐ No (Go to Item IV)

1. What is the design basis for the control system?

_____ 10-Year, 24-Hour Storm (specify inches) _____
_____ 25-Year, 24-Hour Storm (specify inches) _____
_____ Other (specify inches) _____ (type) _____

2. Report the number of acres of contributing drainage _____ (acres)

3. Report the design safety factor _____ (safety factor)

D. The following items shall be attached to this form:

1. A signed certification statement indicating the facility is in compliance with all applicable setback features.

2. A waste management plan indicating the amount of waste generated and how it is to be used.

III. CONCENTRATED AQUATIC ANIMAL PRODUCTION OPERATION CHARACTERISTICS

A. For each outfall, give the maximum daily flow, maximum 30-day flow, and the long term average flow.

Outfall Number	Flow (gallons per day)		
	Maximum Daily	Maximum 30 Days	Long Term Average

B. Indicate the total number of ponds, raceways, and similar structures in your facility.

Ponds _____ Raceways _____ Other _____

C. Provide the name of the receiving water and the source of water used by your facility:

Receiving Water _____ Water Source _____

D. List the species of fish or aquatic animals held and fed at your facility. For each species, give the total weight produced by your facility per year in pounds of harvestable weight, and also give the maximum weight present at any one time.

Cold Water Species			Warm Water Species		
Species	Harvestable Weight (pounds)		Species	Harvestable Weight (pounds)	
	Total Yearly	Maximum		Total Yearly	Maximum

E. Report the total pounds of food few during the calendar month of maximum feeding.

Month _____ Pounds _____

IV. CERTIFICATION

I certify under penalty of law that this document and all attachments were prepared under my direction or supervision in accordance with a system designed to assure that qualified personnel properly gather and evaluate the information submitted. Based on my inquiry of the person or persons who manage the system, or those persons directly responsible for gathering the information, the information submitted is to the best of my knowledge and belief, true, accurate, and complete. I am aware that there are significant penalties for submitting false information, including the possibility of fine and imprisonment for knowing violations.

NAME AND OFFICIAL TITLE (type or print)	TELEPHONE NUMBER (area code and number)
Mr. ☒ Ms. ☐ Steve Storm, Vice President	601-948-6813
SIGNATURE	DATE SIGNED

If according to 401 KAR 5:072 a second signature is necessary, please provide below.

NAME AND OFFICIAL TITLE (type or print)	TELEPHONE NUMBER (area code and number)
Mr. ☑ Ms. ☐ Steve Storm, VP	601-948-6813
SIGNATURE Steve Storm	DATE SIGNED 6/26/08

Legal Descriptions

LAYER COMPLEX LEGAL DESCRIPTION

TRACT 1:
Beginning on an iron pin in the West right of way of Kentucky State Hwy 181 where it intersects with the South right of way of the CSX Transportation Railroad, thence; along the West right of way of Kentucky Hwy 181 South 16 degrees 45'41" East 1884.94 feet to an iron pin in said right of way, thence; continuing along said right of way a curve to the right with a delta angle of 10 degrees 23'02" a radius of 5700.00 and a curve length of 1033.03 feet to an iron pin in said right of way and being a corner of the Downer property, thence; along two (2) of Downer's lines as follows, South 63 degrees 59'31" West 1317.81 feet to an iron pin as a fence corner, thence;North 14 degrees 55'00" West 565.04 feet to an iron pin, Downer's northeast corner and the southeast corner of the L. Sadler property, thence; along four (4) of L. Sadler's lines as follows, North 14 degrees 38'43" West 1383.37 feet to an iron pin at a fence corner, thence; South 81 degrees 35'26" West 1027.54 feet to an iron pin, thence; North 66 30'00" West 2667.77 feet to an iron pin at a fence corner, thence; North 23 degrees 05'24" East 1441.75 feet to an iron pin at a fence intersection L. Sadler's corner in D. Stevenson's South line, thence; along two (2) of D. Stevenson's lines as follows, South 68 degrees 09'53" East 436.64 feet to an iron pin at a fence corner, thence; North 23 degrees 05'43" East 1812.83 feet to an iron pin D. Stevenson's corner in the South right of way of the afore said CSX Transportation Railroad, thence; along the South right of way of said railroad South 50 degrees 28'39" East 3513.54 feet to the point of beginning. Containing 290.10 acres according to survey made by Michael V. Holmes and Assoc. dated 03/07/91.

PULLET FARM LEGAL DESCRIPTION

BEGINNING at an iron pin (old) at the intersection of the north right of way of the CSX Railroad and the east right of way of Kentucky Highway 181, said iron pin being 56.2 feet, more or less, north of the centerline of said CSX Railroad and 30 feet, more or less, east of the centerline of said Kentucky Highway 181; THENCE continuing with said east right of way of Kentucky Highway 181, North 16 degrees 43 minutes 40 seconds West for a distance of 72.75 feet to an iron pin (new) in said east right of way, said iron pin being the southwest corner of a 147.11 acre tract belonging to Noah Yoder; THENCE leaving said east right of way and with the south line of said Yoder, North 83 degrees 12 minutes 26 seconds East for a distance of 1892.00 feet to an iron pin (old), said iron pin being the southeast corner of said Yoder; THENCE leaving said south line of Yoder and on a new line, South 02 degrees 01 minutes 15 seconds West for a distance of 1694.97 feet to a point, said point being in the north line of the Gregory property; THENCE with said north line of Gregory, South 65 degrees 23 minutes 19 seconds West for a distance of 71.07 feet to a point, said point being the northwest corner of the Gregory property, said point also being in said north right of way of said CSX Railroad; THENCE leaving said north line of Gregory and with the north right of way of said CSX, North 50 degrees 28 minutes 38 seconds West for a distance of 2247.16 feet to the point of beginning and according to a survey dated November 25, 1996, by Joseph C. Deering, Kentucky Registered Land Surveyor License Number 3171 of Patrick Engineering Inc.

Together with and subject to covenants, right of ways, easements, and restrictions of record.
Said property contains 39.126 acres more or less.

Setback Features Certification

SETBACK FEATURES SUMMARY AND CERTIFICATION ATTACHMENT

II.D, Item 1

A USGS digital orthophoto quadrangle map of the subject site and blueprints of recently constructed buildings were combined to evaluate setback features. Information regarding nearby structures was provided by Marc Ashby, General Manager of the Cal-Maine facility and a long-time resident of the area. Karst features on the Cal-Maine property were identified through review of a topographic map, orthophoto quadrangle map, and surveyed elevations of the ground surface on the west side of the Layer Farm property; interviews with Mr. Ashby; and a visual inspection of each suspect area by a geologist trained in karst geology. The attached figure (Poultry Houses with Setbacks) presents the Pullet Farm poultry houses and the Layer Complex poultry houses with setback buffers. As indicated in the figure:

- The poultry houses are not located within 1,500 feet of a dwelling not owned by applicant, or a church, school, schoolyard, business, park or other structure to which the general public has access. From the poultry houses, the nearest dwelling not owned by Cal-Maine is the residence associated with the hog farm north of the Cal-Maine property.

- The poultry houses are not located within 2,000 feet of an incorporated city limit. The nearest incorporated city limit is the town of Guthrie, well over 1 mile to the southeast;

- The poultry houses are not located within 150 feet of a lake, river, or blue-line stream. No lakes or rivers are in the vicinity of the Cal-Maine property. The nearest perennial (blue-line) stream is the unnamed tributary of Spring Creek, to the south of the site.

  According to 401 KAR 5:002, "Karst feature" means a naturally occurring feature formed by the dissolution of carbonate rock including but not limited to a sinkhole drain, karst window, swallet, spring, sinking stream, or cave. No karst features have been noted within 150 feet of the poultry houses. The presence of karst features in the vicinity of the western poultry houses was assessed prior to their construction as described in the enclosed letter report (Todd Hughes to Bob Scott, dated July 31, 2000). The western poultry houses were constructed more than 150 feet from the two karst features identified on the Cal-Maine property, as shown on the updated figure titled Karst Features Investigation, Layer Complex. (A third known karst feature is present on the property near the northwest border of the site, in the wooded area adjacent to the railroad and well beyond the 150-foot setback requirement. The third karst feature is not designated on the Karst Features Investigation map.)

- The poultry houses are not within 300 feet of a water well not owned by applicant. Water wells within 300 feet of the poultry houses are owned by Cal-Maine Foods, Inc.

- The poultry houses are not within one mile of downstream water listed in 401 KAR 5:030 as exceptional water or outstanding national resource water, or outstanding state resource water. No Todd County waters are listed in 401 KAR 5:030.

- The poultry houses are not within one mile of a downstream public water supply surface water intake.

- The poultry houses are not within 150 feet of primary roadways.

- The poultry houses are not within 100 feet of secondary roadways.

Other Siting Considerations

The poultry houses are located in the recharge basin and groundwater protection area for the Meriwether Spring, a karst spring. Meriwether Spring was formerly the sole water-supply source for Guthrie, Kentucky; however, Meriwether Spring is no longer used as a water supply.

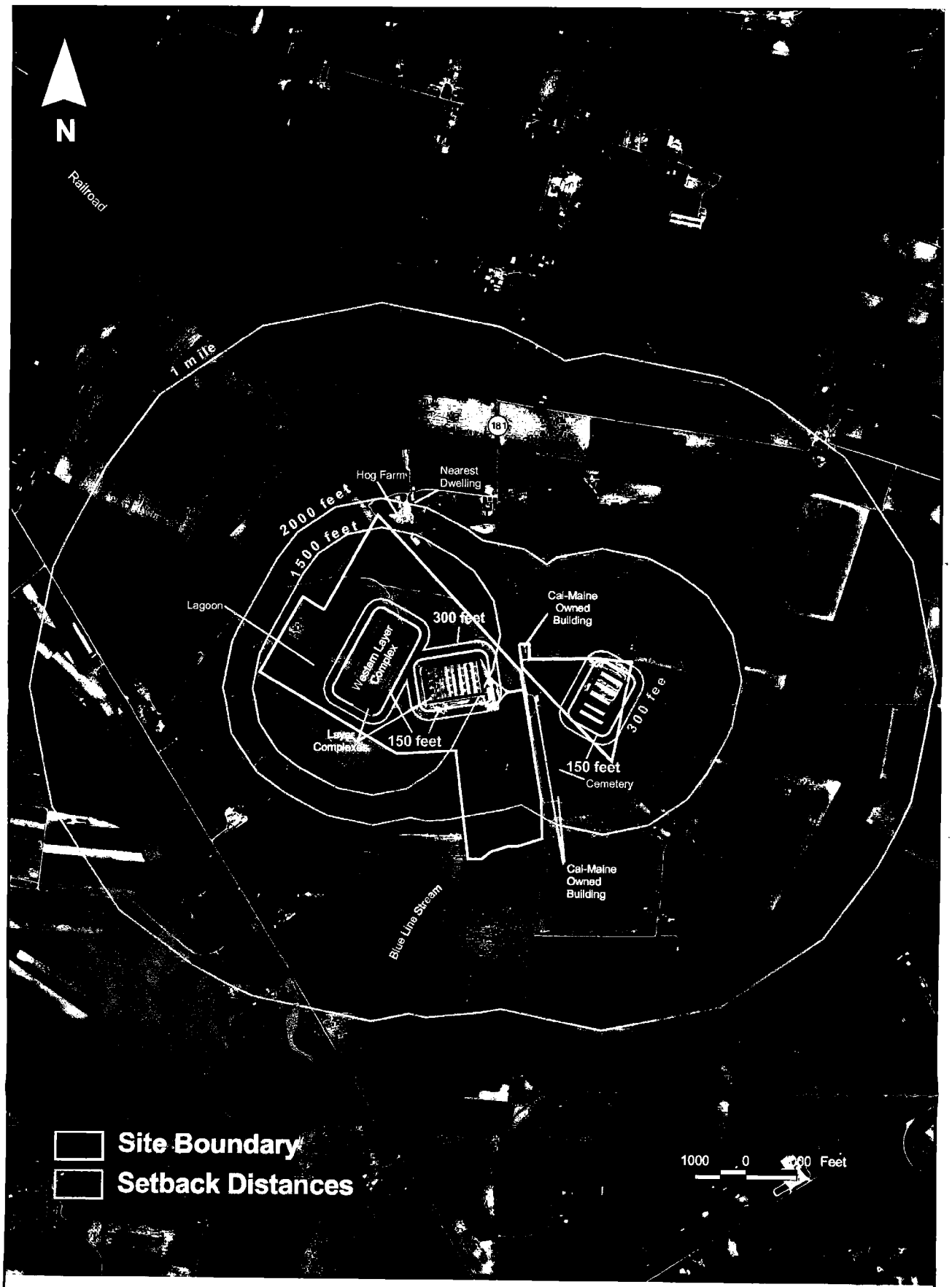
Todd and Logan Counties are now supplied water from the Cumberland River via a pipeline. According to Mike McGee (270-483-9985), engineer for the regional water supply project, the reason for using an alternate water supply source was not the quality of the water from the spring, but rather concerns about the quantity of water available. According to Mr. McGee, tests of the Meriwether Spring water have not indicated a water quality problem.

SETBACK FEATURES CERTIFICATION

I certify under penalty of law that this document and all attachments were prepared under my direction or supervision in accordance with a system designed to assure that qualified personnel properly gather and evaluate the information submitted. Based on my inquiry of the person or persons who manage the system, or those persons directly responsible for gathering the information, the information submitted is to the best of my knowledge and belief, true, accurate, and complete. I am aware that there are significant penalties for deliberately submitting false information, including the possibility of fine and imprisonment for knowing violations.

Signature & Title

Date 8/26/03



ENSAFE

Cal-Maine Foods Inc.
Guthrie, Kentucky
Poultry Houses with Setbacks

Date: 8/27/2003

File: glssafs/projects/cal-maine/cal-maine3.apr

Waste Management Plan

Waste Management Plan

The Cal-Maine Foods facility in Guthrie, Kentucky, has implemented a Comprehensive Nutrient Management Plan (CNMP) that addresses waste management at this farm. Samples of chicken manure, wastewater, and soil from farm fields are collected and analyzed annually. The CNMP is updated every year based on the most recently available laboratory data for manure, wastewater, and soil nutrient content. The CNMP attached here includes the 2007 laboratory data; data and reports from previous years are available at the site.

The waste management strategy can be summarized as follows:

1. Cal-Maine applies approximately 3 tons per acre of composted chicken manure onto land-application fields on this farm, once every other year.

2. Cal-Maine transfers the remaining composted poultry manure to other farmers for offsite land application on other farms.

3. Wastewater from the treatment plant and the lagoon is spray irrigated onto designated fields at rates determined by annual soil tests and the nutrient content of the wastewater. The treatment plant effluent can be transferred to the lagoon for irrigation on the lagoon irrigation fields as needed to achieve a desirable nutrient balance.

Details of the waste management practices in use at this facility are provided in the attached CNMP.

COMPREHENSIVE NUTRIENT MANAGEMENT PLAN

Cal-Maine Foods, Inc.
9729 Guthrie Road
Guthrie, Kentucky

EnSafe Project Number
2113-031

Prepared for:

Cal-Maine Foods, Inc.
Guthrie, Kentucky

Prepared by:

EnSafe Inc.
5724 Summer Trees Drive
Memphis, Tennessee 38134
(901) 372-7962
www.ensafe.com

June 8, 2004

(Revised from the previous CNMP, dated September 27, 2001)

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List of Figures

List of Appendices

1.0 INTRODUCTION

This site-specific Comprehensive Nutrient Management Plan (CNMP) has been developed as required by Kentucky Pollutant Discharge Elimination System (KPDES) individual permit KY0103888 for the Cal-Maine Foods, Inc. (Cal-Maine) poultry farm in Todd County, Guthrie, Kentucky. This CNMP meets the requirements of the Kentucky Natural Resources Conservation Service (NRCS) Conservation Practice Standard Code 590, *Nutrient Management* (a copy of this document is in Appendix A). The U.S. Environmental Protection Agency (EPA) Comprehensive Nutrient Management Planning Technical Guidance, dated December 1, 2000, was used during development of a CNMP dated September 27, 2001, for the Cal-Maine Guthrie farm. The 2001 CNMP was updated to create this 2004 CNMP, which includes the modifications that have occurred at the Guthrie farm since the 2001 plan was developed. Changes in the NRCS standard or in applicable federal, state, or local regulations or policies may necessitate future revisions of the plan, and portions of the plan are updated annually, as necessary to reflect changing conditions at the Cal-Maine Guthrie farm. The practices described in this CNMP are implemented in conjunction with the Best Management Practices (BMP) Plan, dated August 7, 2000, already in place at the Cal-Maine Guthrie facility.

The primary purpose of this CNMP is to achieve the correct nutrient levels of nitrogen and phosphorus needed to grow planned crops by balancing the nutrients already in the soil with the nutrients in land-applied animal waste. Together with the BMP plan, the CNMP documents actions that Cal-Maine takes to reduce the potential for impairment of surface and groundwater resources. The BMP plan addresses waste generation and management at this facility, including manure and wastewater handling and storage and dead animal disposal. The CNMP addresses application of wastes (poultry litter and egg processing wastewater) to the Cal-Maine farmland, including these specific CNMP components: land treatment, nutrient management, record keeping, and other BMPs specified in Cal-Maine's permit to be included in the CNMP.

In accordance with the Kentucky Agriculture Water Quality Act, a Kentucky Agriculture Water Quality Plan (AWQP) is required for the Cal-Maine Guthrie facility. The AWQP specifies BMPs to achieve minimum acceptable quality levels for planning, siting, designing, installing, operating, and maintaining agricultural facilities in the Commonwealth of Kentucky. Agricultural facilities are

expected to develop individual plans that fit their specific circumstances, using the BMPs in the AWQP as guidance. The BMP plan and this CNMP outline the specific practices Cal-Maine employs in its Guthrie facility to meet the requirements of the KPDES individual permit conditions and the AWQP guidelines.

2.0 SITE INFORMATION

The Cal-Maine Guthrie facility occupies a site on KY 181, also known as Guthrie Road, at the intersection of the CSX Railroad crossing in Todd County. The site address is 9729 Guthrie Road, Guthrie, Kentucky 42234, and the mailing address is P.O. Box 40, Guthrie, Kentucky 42234. The facility's telephone number is (270) 483-2002.

The facility consists of two parcels of land. The larger parcel, 290 acres in size, is located southwest of the KY181 and CSX Railroad intersection. This parcel is designated as the Layer Farm on Figure 1. The Layer Farm has 23 layer houses, two egg processing areas, offices, an emergency generator building, and a truck maintenance shop. The smaller parcel, about 40 acres in size, is located northeast of the KY181 and CSX Railroad intersection. This parcel contains five pullet houses and a small generator/storage building. This parcel is identified as the Pullet Farm on Figure 1.

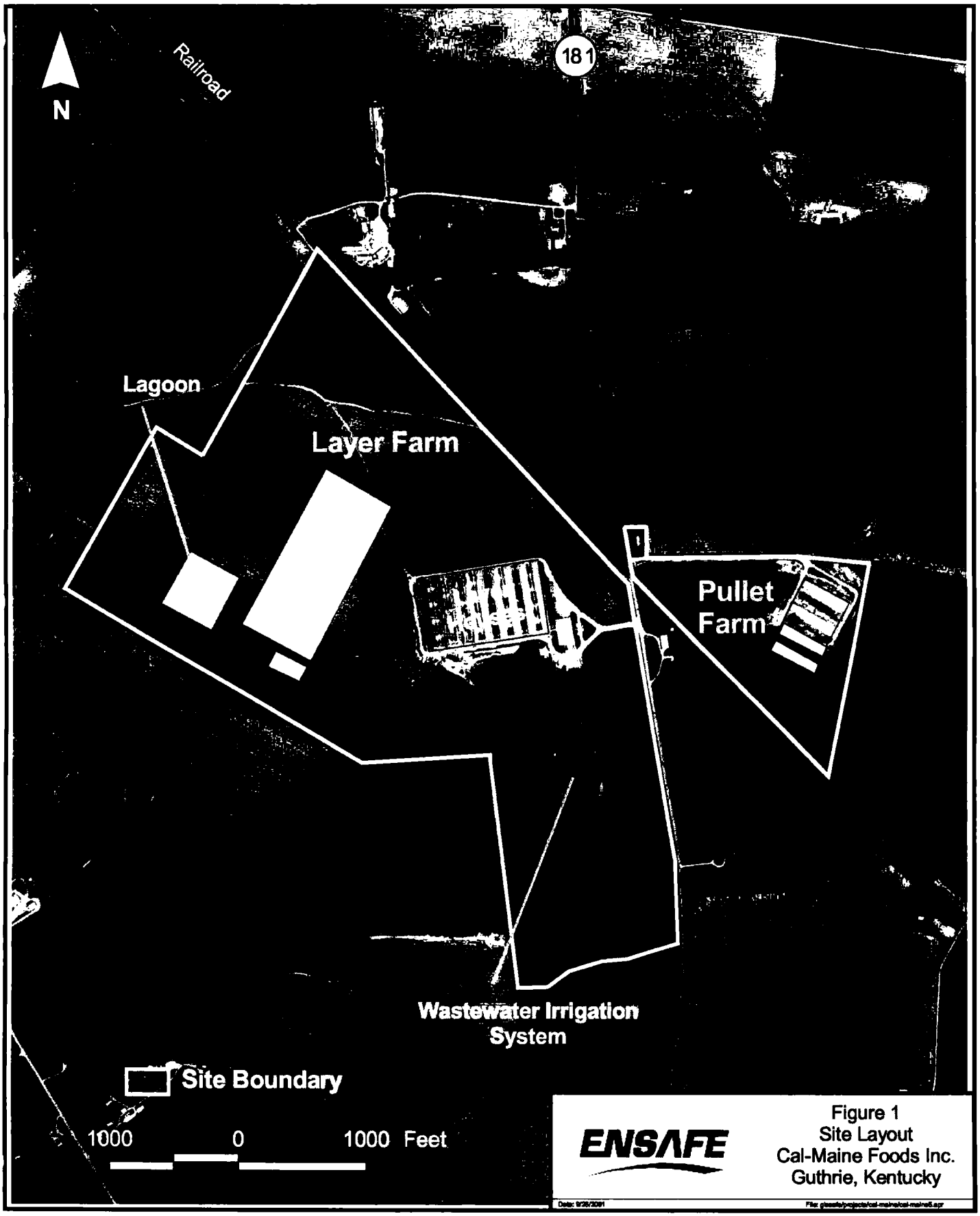

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Figure 1
Site Layout
Cal-Maine Foods Inc.
Guthrie, Kentucky

3.0 PRODUCTION INFORMATION

3.1 Litter Production

The Cal-Maine Guthrie facility houses an approximate maximum of 2,500,000 laying hens, with an average weight of 3.5 pounds per hen. This number of laying hens produces approximately 150,000 dozen eggs per day.

The pullet farm houses chicks that serve as replacements for the laying hens. The pullet farm is regularly stocked with one-day-old chicks, one house at a time. The birds are transferred to the egg production facility when they are approximately 18 weeks old. The maximum population of the pullet facility is approximately 570,000 nine-week-old birds, with an average weight of 1.5 pounds each.

Cal-Maine is in the process of reducing the number of laying hens and pullets per house, so that the number of birds on the layer farm and pullet farm combined is expected to decrease from nearly 3,000,000 birds in 2004 and 2005 to approximately 2,600,000 birds in 2008 and beyond. The decreased number of hens and pullets will result in less chicken litter production over time.

As described in the BMP plan, chicken litter is stored in the lower portion of the high-rise poultry houses and removed once per year. Approximately 80 15-ton loads of manure are produced from each layer house per year, and approximately 50 15-ton loads of manure are produced from each pullet house per year. Exact amounts can vary, depending on the number of chickens per house. **Appendix B** contains an estimate of the annual chicken litter production.

3.2 Nutrient Production from Chicken Litter

Samples of Cal-Maine Guthrie chicken litter are collected annually by the Todd County Extension Office and submitted to the University of Kentucky (UK) Lexington Lab for analysis. **Appendix B** contains a summary of the most recent laboratory results for nitrogen, orthophosphate and potassium content of the chicken litter, along with the average value for each nutrient.

Appendix B also contains a calculation for the estimated annual amount of nutrients produced in the chicken litter and available for land application. This estimate is recalculated annually, based on the most recent chicken litter nutrient values.

Please note that Cal-Maine does not utilize the entire volume of litter on its own farm. The majority of poultry litter produced is land-applied offsite.

3.3 Wastewater Production

In addition to chicken litter, nutrients for land application are available from wastewater generated at the Layer Farm. At the pullet farm, small quantities of domestic wastewater are generated and disposed of via a septic system, so pullet farm wastewater is not considered a contributor to nutrient production.

Wastewater generated at the Layer Farm is treated in an onsite package treatment plant and/or in an aerobic lagoon. The wastewater treated in the wastewater treatment plant consists of approximately 4,000 gallons per day (gpd) of egg processing wastewater and domestic wastewater, combined. The wastewater treated in the aerobic lagoon consists of approximately 3,000 gpd of egg processing wastewater. However, treated effluent from the wastewater treatment plant can be routed to the lagoon for spray irrigation on the north field.

The package treatment plant, Model No. SC-26K, was manufactured by Santec Corporation of Aurora, Colorado, and installed in November 1991. The treatment plant is operated by Cal-Maine, with the part-time assistance of an outside consultant who is certified as a Class III Wastewater Operator. The plant is a modified extended aeration plant with activated sludge. The wastewater first passes through an eggshell strainer basket, then into three complete-mix flow-through type reactors in series where organic waste is removed. The wastewater then flows into a fourth reactor, which has a gentle aeration section and a clarifier. Sludge from reactor 4 can be directed back into reactor 3 or wasted to the 5,000-gallon sludge holding tank. The sludge in the holding tank is dried by evaporation and then removed as a solid waste by an outside contractor. Effluent from reactor 4 is directed to a 10,000-gallon effluent holding tank and can be routed to the wastewater lagoon for

further processing, or directly land applied (spray irrigated) on approximately six acres of the south field of the Layer Farm.

An estimated 3,000 gpd of egg processing wastewater is routed to a naturally aerated lagoon for treatment, in addition to the effluent from the wastewater treatment plant which is not directly land applied. The 250- by 300-foot lagoon has a surface area of approximately 75,000 square feet. The lagoon is sized for a retention time of 600 days at an estimated flow rate of 3,500 gpd. With the addition of the effluent from the package treatment plant, the retention time decreases to 150 days, but treatment efficiencies are not adversely impacted, because the additional water has already been treated. Lagoon wastewater that is not depleted by evaporation will be drawn down as needed and spray irrigated onto approximately 15.25 acres of the north field of the Layer Farm. The irrigation rate is controlled to prevent runoff from the effluent discharge.

The wastewaters from the treatment plant and from the lagoon are sampled at least annually, and sometimes more often. The concentrations of nutrients available in the wastewater are used in the calculations of wastewater application rates to the fields.

Plant-Available Nitrogen

The treated wastewater contains nitrogen in the forms of nitrate and ammonia. Some organic nitrogen may also be present, but organic nitrogen is not immediately available to plants. Both ammonia nitrogen and nitrate nitrogen are forms of nitrogen that are readily available to plants. However, considerable amounts of ammonia nitrogen can be lost to the air through volatilization as ammonia gas, particularly in a spray irrigation system. Nitrate nitrogen is readily available to crops. However, if excess water is present, nitrate nitrogen can be lost through leaching or denitrification. Because nitrogen can be readily lost in field applications, estimates of nitrogen losses are often calculated to be 50% to 80% of the total available nitrogen.

Phosphorus

In general, most effluent phosphorus is soluble and readily available for plant use. Ninety percent availability has been commonly used for phosphorus calculations.

Appendix C contains the most recent laboratory data for the lagoon and treatment plant effluents, and calculations of the nutrients available in the spray irrigation wastewater. These estimates are recalculated annually based on the most recent laboratory data for wastewater samples.

4.0 LAND APPLICATION SITE INFORMATION

All of the wastewater effluent and some of the chicken litter produced by Cal-Maine is land-applied on the Layer Farm. No wastewater or poultry manure are land-applied on the pullet farm; instead, chemical fertilizer is used for these crops. Poultry litter not used on Cal-Maine farmland is sold to outside farmers for offsite use.

Cal-Maine does not send any of the wastewater generated at this facility offsite; all of the wastewater is land-applied on the farm. Cal-Maine has the option of decreasing the area devoted to land application of chicken manure, in order to increase the area for wastewater application, if desired.

4.1 Field Designations and Soil Types

There are two fields on the Cal-Maine Layer Farm, as depicted on Figure 2. The north field comprises the land on the north and northwest sides of the layer houses and the area between the layer houses. Approximately 76 acres of the north field are used for crops. The lagoon wastewater effluent is spray irrigated onto approximately 15 acres of the north field. The south field, approximately 110 acres, comprises land south of the layer houses and the south side of the land southwest of the new layer complex. Approximately 82 acres of the south field are used for growing crops. When the wastewater treatment plant effluent is directly land-applied, it is spray irrigated onto approximately six acres of the south field. The Cal-Maine pullet farm field contains about 19.7 acres, as shown in Figure 3.

A soil map from the Soil Survey of Todd County, Kentucky, (Figure 4) indicates the soil types in the Cal-Maine fields. The general soil type in the Cal-Maine vicinity is Pembroke-Nicholson-Crider, which consists of well-drained and moderately well-drained, nearly level to sloping deep soils that are loamy and were formed in loess and residuum from limestone, on broad upland plains. Detailed soil classifications for the Cal-Maine fields include a mixture of the following soil types:

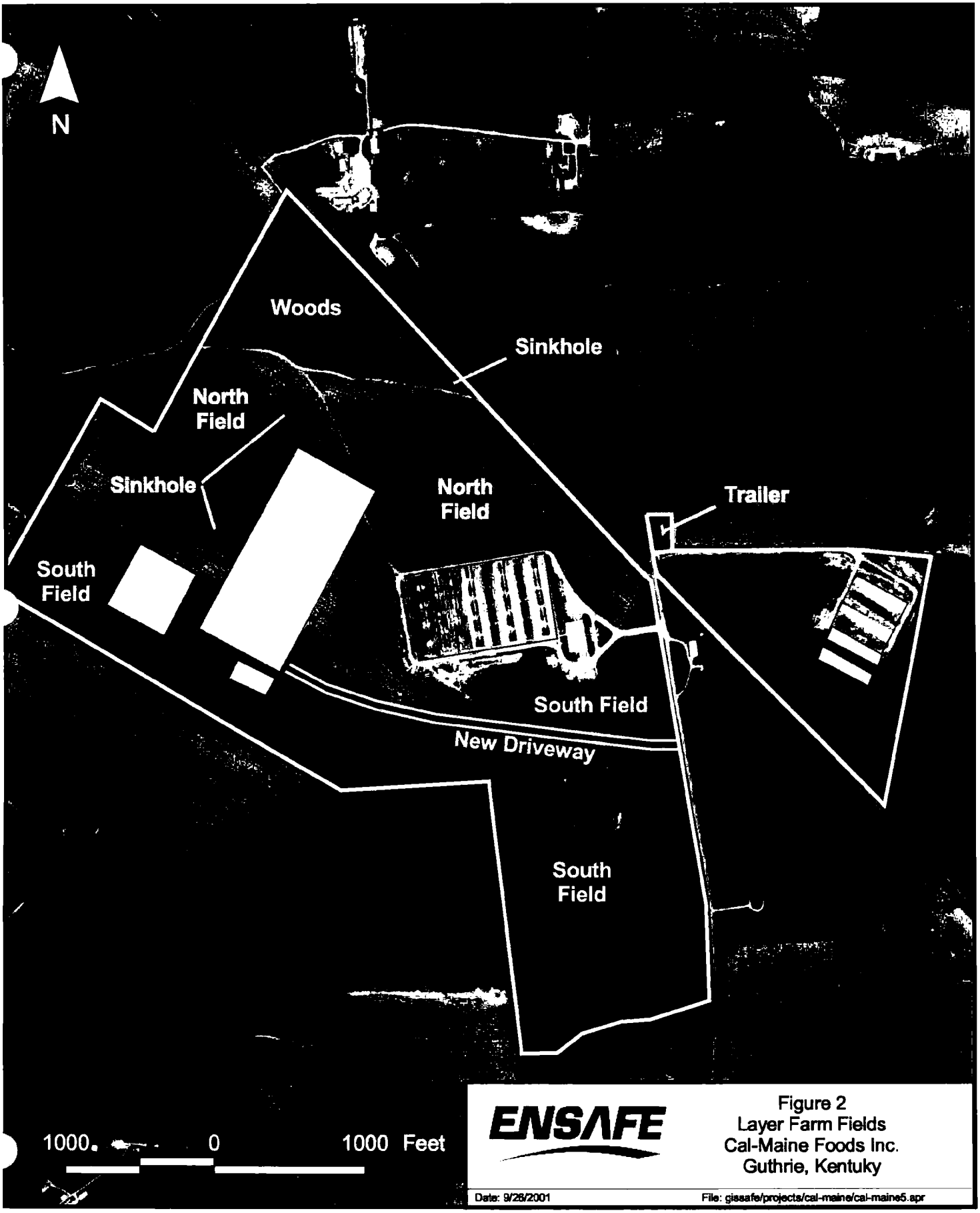

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Figure 2
Layer Farm Fields
Cal-Maine Foods Inc.
Guthrie, Kentuky

Date: 9/26/2001

File: gissafe/projects/cal-maine/cal-maine5.apr

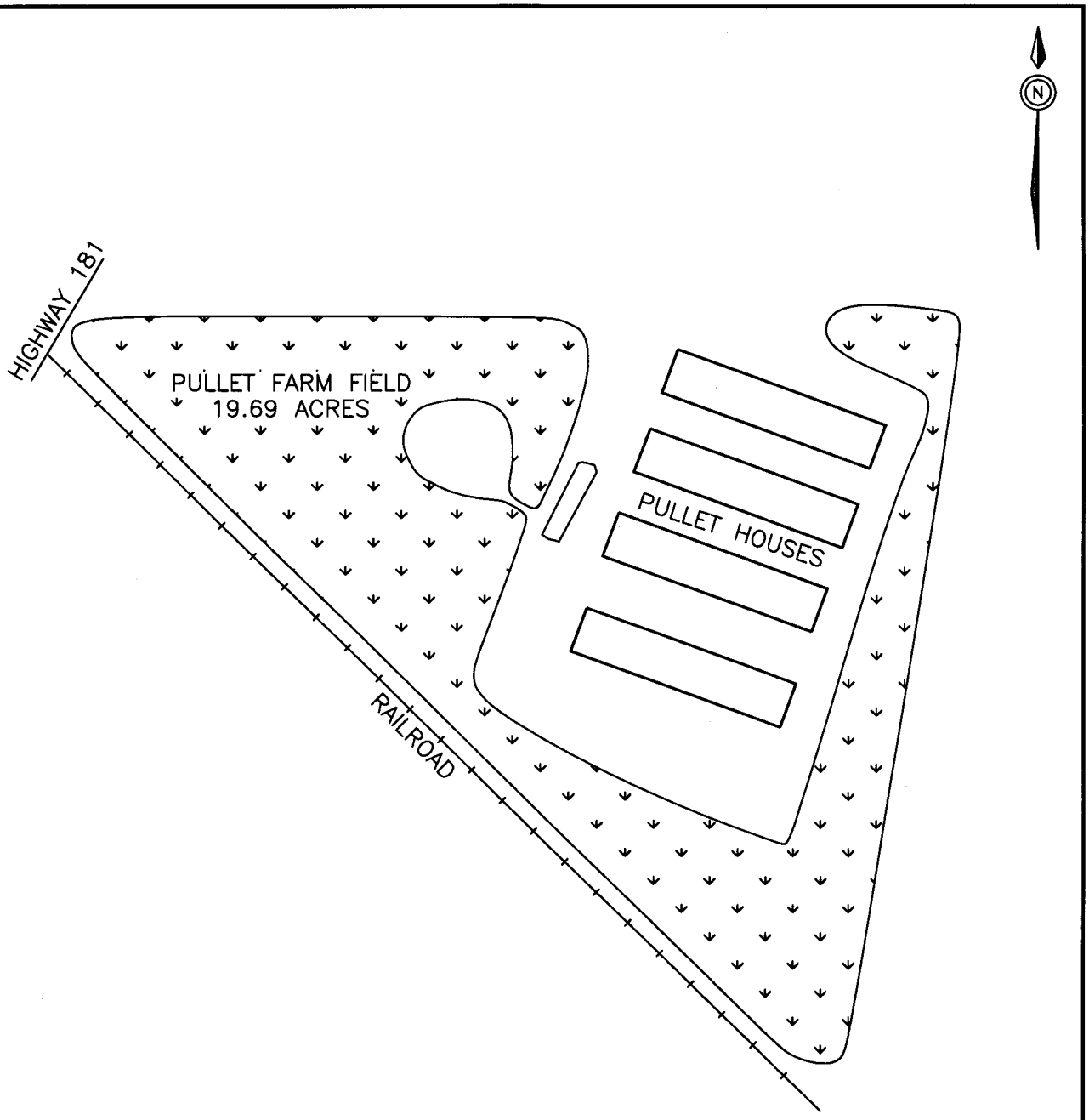

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FIGURE 3
PULLET FARM FIELD
CAL-MAINE FOODS, INC.
GUTHRIE, KENTUCKY

DWG DATE: 09/24/01	NAME: 2113031W001

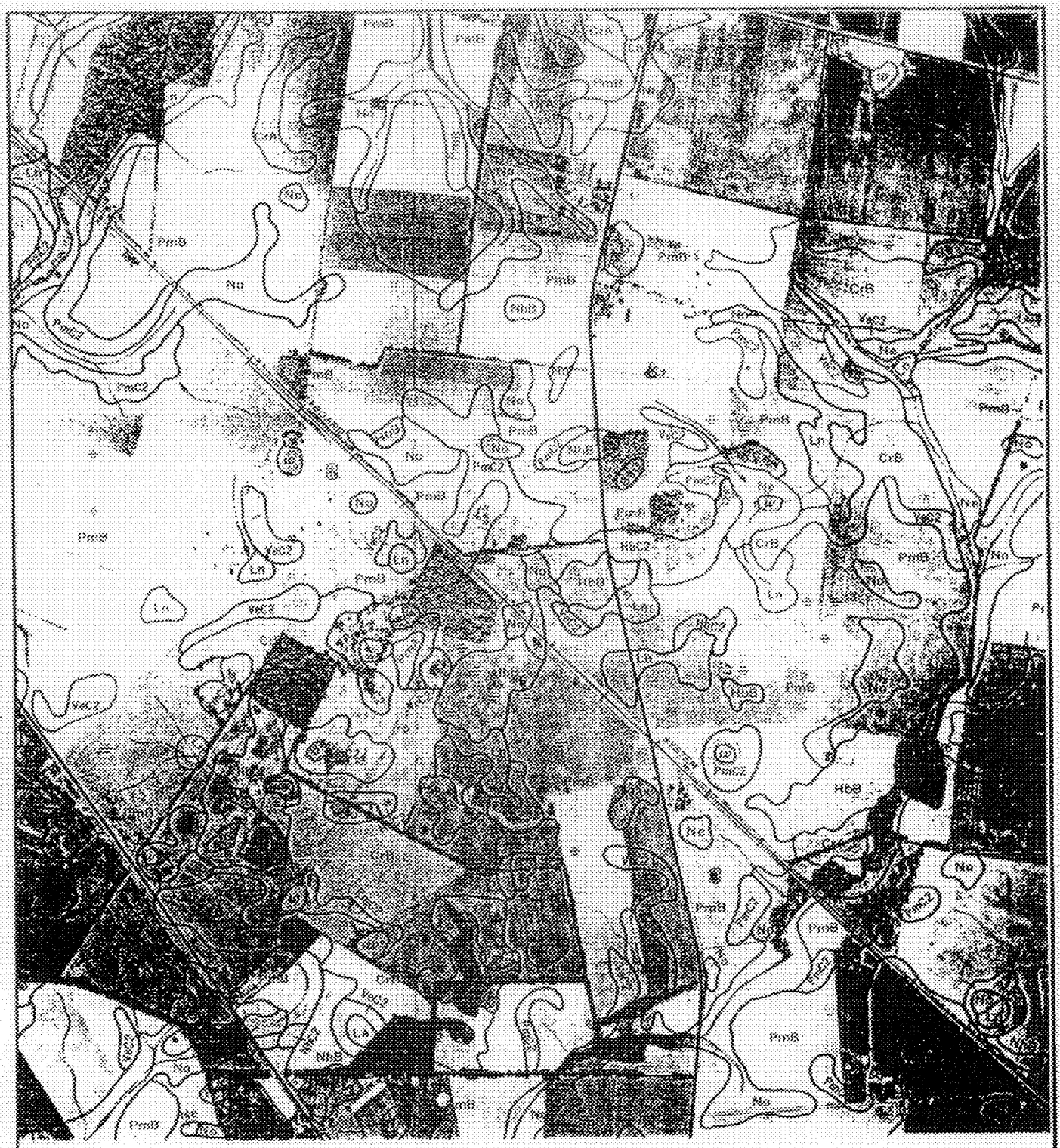

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FIGURE 4
SOIL SURVEY MAP OF
CAL-MAINE FOODS
FROM SOIL SURVEY OF
TODD COUNTY, KENTUCKY

DWG. DATE: 09/24/01 | NAME: BORDER

- Pembroke silt loam (PmA, PmB, and PmC2): deep, well-drained, moderately permeable soils on broad upland ridges and side slopes of the Mississippian Plateau. These soils formed in loess and the underlying residuum from limestone or old alluvium. PmA slopes are 0 to 2%; PmB slopes are 2 to 6 %; and PmC2 slopes are 6 to 12%, eroded. Pembroke silt loam is in hydrologic group B, soils having a moderate infiltration rate when thoroughly wet. The PmB soil type predominates in the pullet farm field and on the eastern side of both the north and the south Layer Farm fields.

- Hammack-baxter complex (HbB, HbC2): deep, well-drained, moderately permeable soils on ridgetops and side slopes of the karst Mississippian Plateau area. These soils formed in residuum from cherty limestone (Baxter series) or in a thin loess mantle and the underlying residuum from cherty limestone (Hammack series). HbB slopes are 2 to 6%, and HbC2 slopes are 6 to 12%, eroded. Hammack-baxter complex soils are in hydrologic group B. The HbB soil type predominates on the southeastern side of the pullet farm field and on the western side of the north Layer Farm field.

- Crider silt loam (CrA, CrB): deep, well-drained, moderately permeable soils on broad upland ridges and side slopes. These soils formed in loess and the underlying residuum from limestone or old alluvium. CrA slopes are 1 to 2% and CrB slopes are 2 to 6%. Crider silt loam soils are in hydrologic group B. The CrB soil type predominates on the western side of the south Layer Farm field, along with the HbC2 soil type.

- Vertrees silty clay loam (VeC2): deep, well-drained, moderately permeable soils on side slopes of karst uplands, underlain by limestone. These soils formed in clayey residuum from limestone. VeC2 slopes are 6 to 12%, eroded, and this soil is in hydrologic group B. The VeC2 soil type is present in small localized areas of the south Layer Farm field.

- Nolin silt loam (No): deep, well-drained, nearly level soils on flood plains and in upland depressions. These soils formed in silty alluvium washed from soils derived from limestone, sandstone, siltstone, shale, and loess. Slopes range from 0 to 3%. Nolin silt

loam soils are in hydrologic group B. The No soil type is present in small localized areas in the south Layer Farm field.

- Lindside silt loam (Ln): deep, moderately well-drained, nearly level soils on flood plains and in upland depressions. These soils formed in silty alluvium washed from soils derived from limestone, sandstone, siltstone, shale, and loess. Slopes range from 0 to 2%. Lindside silt loam soils are in hydrologic group C, soils having a slow infiltration rate when thoroughly wet. The Ln soils are found in a small area in the north Layer Farm field.

4.2 Location of Sensitive Areas

Environmentally and socially sensitive areas, such as karst features and dwellings not owned by Cal-Maine, require special consideration during land application of manure. Both the Kentucky Concentrated Animal Feeding Operation (CAFO) regulations and the Kentucky AWQP require setbacks (not necessarily of the same distance) from sensitive areas during land application of poultry manure.

Because Cal-Maine is a CAFO operator, it must adhere to CAFO setback distances for poultry houses and manure storage areas. However, Cal-Maine does not farm the Layer Farm or the pullet farm land. Instead, the lands are leased to outside farmers who grow crops on the leased land. One of those farmers purchases manure from Cal-Maine and applies the manure to the leased Layer Farm fields. Because this farmer is not a CAFO operator, it is Cal-Maine's understanding (based on communications with the Kentucky Division of Water) that he is required to adhere to the land application setbacks specified in the AWQP, but **not** to the CAFO regulation setbacks.

As shown on Figure 2, three sinkholes (karst features) are on the Layer Farm. One of the sinkholes is next to the railroad and two are near the west layer complex, all in the north field. As stated in the BMP plan, Cal-Maine adheres to the required setback distances for sinkholes: poultry houses and litter storage areas are at least 150 feet from the sinkholes, and poultry manure is land-applied no closer than 75 feet. There are no identified sinkholes on the pullet farm.

Waterways on and near the farms are shown on Figure 4. A pond is indicated on the pullet farm field, but no land application of manure occurs on the pullet farm. A blue-line stream south of Cal-Maine's property is more than 150 feet from the property line (the required setback distance for land application is 150 feet). The soil survey map (which is based on a 1981 aerial photograph) indicates that an intermittent stream on the south Layer Farm field flows into the blue-line stream to the south, but site reconnaissance indicates that this intermittent stream is no longer present. The current topography of the south field is such that water sheet-flows over the field and, if large volumes of water are present, collects in a low area north of the property line.

A trailer used as a residence, which is not owned by Cal-Maine, is located near the pullet farm, as shown on Figure 1. In accordance with the setback requirements listed in the AWQP and Cal-Maine's BMP plan, poultry manure will be applied no closer than 50 feet from property lines and no closer than 300 feet from the trailer.

A state roadway (Highway 181) lies adjacent to the Cal-Maine properties, as shown on Figure 1. CAFO regulations specify that poultry manure cannot be applied within 75 feet of state roadways; the AWQP does not have a roadway setback restriction. As stated previously, it is Cal-Maine's understanding that the farmer who is applying the poultry manure must comply with the AWQP plan but not with the CAFO setbacks for land application.

Cal-Maine owns the water wells near the fields. No other water wells are known to be within the 200-foot setback for poultry manure land application areas.

Cal-Maine notes that crops may be grown closer to the sensitive areas than indicated by setback distances, as long as there is no poultry manure land application within the setback distance.

4.3 Land Treatment Practices

Land treatment practices implemented on Cal-Maine farmland include:

- No-till farming methods.
- A crop residue ground cover of at least 40% at all times.
- Incorporation of the poultry litter into the soil, with minimal tillage.
- Maintenance of required setbacks for land application of animal wastes, as specified in the BMP plan.

4.4 Risk Assessment for Potential Nitrogen or Phosphorus Transport from Fields

Nitrogen and phosphorus are the two nutrients most often identified as impairing the quality of groundwater and surface water. Nitrogen leaching from the root zone can be transported to surface water or leach to groundwater. Nitrate, a form of nitrogen, at a concentration of 10 parts per million or greater in drinking water, is a health risk. Phosphorus runoff entering surface water contributes to excessive algae growth, causing low oxygen levels that impair aquatic life and contribute to bad-tasting water. The procedures outlined in this CNMP are designed to minimize the transport of nitrogen to surface and groundwater.

The potential risk for nitrogen transport from fields is mitigated by several practices:

- Calculation of the amount of litter to be applied, based on a nitrogen budget for the specific crops sown.
- Careful timing of litter application to maximize plant uptake of the nitrogen.
- Application of the litter to avoid sensitive areas such as sinkholes.

Application of adequate amounts of manure to meet the calculated nitrogen budget can result in over-application of phosphorus. The potential risk for phosphorus transport is assessed by:

- Testing the soil for extractable phosphorus as determined by the Mehlich III method. If the residual soil test phosphorus level is below 400 pounds per acre, manure can be applied

based on a nitrogen budget. If the residual soil test phosphorus level is above 400, additional assessment of the potential risk for phosphorus transport must be conducted.

- Determining the potential risk of phosphorus movement into water from a field by using the Phosphorus Index for Kentucky. If the soil test level of phosphorus is over 400 pounds per acre and if the phosphorus index is high or very high, the nutrient application budget must be phosphorus-based.

In accordance with the conditions of the KPDES permit, Cal-Maine collects soil samples from land application fields annually, prior to each growing season. The soil samples are analyzed for phosphorus content by the University of Kentucky College of Agriculture, using the Mehlich III method for phosphorus. **Appendix D** contains copies of the laboratory data associated with the soil tests for phosphorus. As long as the soil tests indicate that the phosphorus in the fields is below 400 pounds per acre, the nutrient application rates for the fields can be nitrogen-based.

If soil tests indicate residual phosphorus levels greater than 400, the Kentucky Phosphorus Index can be used to calculate the risk of phosphorus movement from the fields into streams. A Kentucky Phosphorus Index worksheet has been completed for each Layer Farm field and included in **Appendix E**. The calculated phosphorus indexes indicate that there is **medium** potential for phosphorus movement from the Layer Farm fields, which allows Cal-Maine to use a nitrogen-based nutrient budget for calculating waste application rates. The Kentucky Phosphorus Index will be revised each year, if the soil test data warrant or if other index factors change. If the recalculated values should indicate that the potential for phosphorus movement from a field is high or very high, Cal-Maine will adhere to a phosphorus-based nutrient budget for that field.

Steps that Cal-Maine may choose to take that would lower the risk of phosphorus movement include:

- Changing the nutrient application timing so that no application is conducted in December or January.

- Maintaining ground cover immediately following land application so that it is above 60%.

- Changing the nutrient application timing to June through September.

- Modifying the application method to incorporate the manure within 48 hours, or using injection as the application method.

4.5 Crop Rotation, Historical Yield, and Nutrient Removal

The typical 2-year crop rotation practiced on the Cal-Maine farm land is as follows:

Year 1, Spring – Fall: Corn
Year 1: Fall – Spring: Wheat
Year 2: Spring – Fall: Soybeans
Year 2: Fall – Spring: Fallow
Rotation repeats.

This sequence is followed on the north and south portions of the farm separately; i.e., the north field is in year 1 of the sequence when the south field is in year 2. Application of chicken litter to the fields is conducted prior to the planting of the corn crop. Estimated crop nutrient removal values are based on historical crop yields and the NRCS's Agricultural Waste Management Field Handbook, Chaper 6 (see **Appendix F**).

5.0 MANURE AND WASTEWATER APPLICATION PLAN

The primary purpose of nutrient management is to achieve the level of nutrients (e.g. nitrogen and phosphorus) required to grow the planned crop by balancing existing nutrients in the soil with those that will be applied in the manure and other fertilizer sources. At a minimum, nutrient management should prevent the application of nutrients at rates that will exceed the capacity of the soil and planned crops to assimilate nutrients and prevent pollution.

Manure and wastewater application rates are based on these conditions, as established in previous sections of this CNMP:

- Two-year crop rotation is corn followed by double-cropped wheat and soybeans.
- No-till techniques are used on this farm.
- Soils are well-drained.
- Soil test results indicate that phosphorus is high (above 60 pounds/acre) and potassium is very high (above 420 pounds/acre). Therefore, no additions of phosphate (P_2O_5) or potash (K_2O) are required or recommended, even though there will be some crop removal of these nutrients.
- Nutrient application rates are based on nitrogen because soil tests indicate that phosphorus typically is below the threshold value of 400 pounds per acre and/or because the Kentucky Phosphorus Index indicates a medium risk of phosphorus movement from the fields.
- Application rates are based on University of Kentucky AGR-1, *2000-2001 Lime and Fertilizer Recommendations* (a copy of pertinent sections is included in Appendix H).

- Poultry manure has historically been applied on Layer Farm fields on a **4-year rotation (once every four years).** A commercial fertilizer (10-0-0) is used for supplemental nitrogen, based on soil tests.

- Estimated available nitrogen from previous crops and manure applications: Nitrogen recommendations in KY AGR-1 take into consideration contributions from previous crops, such as soybeans. Organic nitrogen available to plants from previous applications of poultry manure is negligible in the fourth year following application, and so is not a factor for estimating the nutrient budget in this case.

- NO manure is applied on land that is spray irrigated.

5.1 Crop Nutrient Requirements and Manure Application Rates

Worksheets for calculating crop nutrient requirements and allowable waste application for each field are included in **Appendix G**. The nutrient requirements are recalculated annually, based on the most recent laboratory data available.

Poultry manure is typically applied on Cal-Maine farmland at a rate of six tons per acre, every fourth year, prior to planting of corn. Because corn is planted every other year in the crop rotation sequence, commercial nitrogen fertilizer is used during corn planting years when manure is not applied. This application sequence mitigates phosphorus buildup in the soil.

The four-year cycle for manure application may be modified to three years for a small portion (10 acres) of the farm, selected based on soil test information. Manure was historically applied to the 10 acres during the third year, instead of the fourth, to allow for onsite disposal of composted material (manure with composted chicken carcasses). Cal-Maine now disposes of chicken carcasses through an offsite rendering process. The modified cycle for composted material will not be implemented as long as there is no composted material to be disposed.

The crop sequence is rotated on the north and south fields so that manure is applied on the Layer Farm every other year, to either the north or south field, with limited application of composted material every year, if necessary. Land application of manure to the Cal-Maine farm is well below the rates allowed by the nutrient budget for nitrogen. A commercial fertilizer (10-0-0) is used to provide supplemental nitrogen, and is applied at rates indicated by soil tests.

5.2 Crop Nutrient Requirements and Wastewater Application Rates

Spray irrigation of wastewater is conducted at a rate that keeps nitrogen application below the rates allowed by the nitrogen budget. Soil tests of spray irrigated fields are conducted annually, for both nitrogen and phosphorus. Because the spray irrigated wastewater can contain high concentrations of phosphorus in particular, the data are scrutinized carefully and the spray irrigation patterns may be modified as a result.

A soil test report for soil in the south irrigation spray field (south field), dated June 20, 2001, indicated a phosphorus level of 287 lbs/acre. A soil test of the same field, dated May 12, 2003, indicated a phosphorus level of 1,076 lbs/acre, which is in excess of the 1,066 lbs/acre cutoff for phosphorus application from any nutrient source. These values indicated a substantial and unexpected increase in soil phosphorus content in this spray field in only two years. Tests in 2003 of two other fields at the facility on which manure is applied indicated soil phosphorus of 197 lbs/acre (south field) and 129 lbs/acre (north field), so the elevated soil phosphorus was related to the effluent being spray irrigated on the field, not to manure application.

The possible causes of the elevated soil phosphorus level were determined to be:

- Elevated phosphorus in the treatment system effluent. A wastewater effluent sample collected April 3, 2003, indicated a total phosphorous concentration of 770 milligrams per Liter (mg/L). A sample of the effluent collected March 23, 2001, had yielded a phosphorus concentration of only 67.5 mg/L. According to the facility's general manager, Mr. Marc Ashby, the egg washwater soap application had been automated, with the result

that the soap content of the washwater was greater. He suspected that the increased soap usage created an increase in the phosphorus concentration of the wastewater.

- An increase in the volume of effluent being spray applied to the south field. The construction of additional poultry houses resulted in additional sanitary wastewater flow to the wastewater treatment plant, estimated at 500 gallons per day. The increased volume of irrigation water could have exceeded the crop capacity to take up the nutrients.

The steps that Cal-Maine took to address the elevated level of phosphorus in the spray irrigation field included:

- discontinuing spray irrigation on the six acre field with the elevated soil phosphorus levels;
- directing the treatment plant effluent into the lagoon;
- discontinuing the use of the automatic soap dispenser, and limit the amounts of soap being added to the egg processing water;
- testing the soil in the south spray field prior to resuming irrigation. For a soil test phosphorus of 801 to 1066 lbs/acre, the phosphorus application rate will be limited to that corresponding to ½ of the estimated removal of phosphorus in the harvested plant biomass, or Cal-Maine may choose to simply not resume irrigation of this field until the residual soil phosphorus is once again below 400; and
- more closely monitoring both the wastewater treatment plant effluent and the soil phosphorus concentrations in the future.

Cal-Maine considers the elevated phosphorus level in the south spray field in 1993 as an indication of the need for continual close monitoring of the phosphorus concentrations in spray irrigation wastewater and in all the spray irrigation fields in the future. Ongoing scrutiny of these

concentrations and quick response to elevated levels will prevent overloading of the soil with phosphorus.

Steps that Cal-Maine may take to mitigate phosphorus concentrations in the spray irrigation fields are:

- Increasing the size of the fields to be irrigated to spread out the nutrients applied.
- Testing the soil from the irrigation fields separately from the rest of the fields.
- More frequent testing of the wastewater effluent to assess whether nutrient concentrations in the wastewater have changed.
- Modifying crop rotation to grow crops that take up more of the nutrients.
- Restricting the timing of the spray irrigation to the growing season.
- Altering the wastewater treatment plant regime.
- Modifying the types of crops grown or the crop rotation cycle.

5.3 Application Timing

A key component of land application is timing. Manure should be applied as close to the planting as possible or when the crop is actively growing in such a way as to prevent it from entering streams, other water bodies, and environmentally sensitive areas. Manure application in the spring, to coincide with corn nutrient needs, is optimal. Additional application of smaller quantities in the fall, to coincide with wheat nutrient needs, is acceptable but not required. Land application of manure is currently conducted from October through March, with a cover crop. No land application occurs when the ground is snow-covered, frozen, or saturated.

Wastewater effluent may be spray irrigated on a semi-continual basis year-round. However, no spray irrigation occurs when the ground is snow-covered, frozen, or saturated. Cal-Maine chooses to concentrate the lagoon wastewater application to the crop growing season. The effluent from the wastewater treatment plant historically has been spray irrigated on a year-round basis, but Cal-Maine has now developed an option of diverting wastewater treatment plant effluent to the lagoon, and may choose to restrict this wastewater application in the future to the primary growing season.

6.0 RECORDKEEPING

At least once a year the animal waste retention structures, holding areas, and land application areas will be visually inspected to evaluate the potential for any wastewater discharges to waters of the Commonwealth of Kentucky. A record of the date of inspection, the name of the inspector, and pertinent comments will be kept on file in the Cal-Maine Guthrie offices.

Additional records that will be maintained by the Cal-Maine facility include:

- Daily precipitation as measured with an onsite rain gauge.
- Daily records of the amount of manure that is land-applied and number of acres utilized during the application, during periods of manure application.
- Daily records of the amount of manure which is transferred offsite and its destination, including the name of the recipient.
- A weekly estimate of the percentage of remaining chicken litter storage capacity.
- Annual laboratory reports of the nitrogen and phosphorus content of the package treatment plant effluent.
- Annual laboratory reports of the nitrogen and phosphorus content of the egg processing lagoon wastewater.
- Phosphorus content of soil in the land application fields.

Records will be maintained for at least five years. The records maintained by Cal-Maine will be available for inspection by representatives of the Division of Water, upon request.

This CNMP will be reviewed with each soil test cycle to determine if adjustments or modifications to the plan are needed. Changes to this CNMP, including modifications in calculated waste application rates and the basis for making such changes, will be maintained with this document.

7.0 OTHER PERMIT REQUIREMENTS

As specified in the KPDES Permit, Cal-Maine will comply with the following BMPs:

Cease of Operation — In the event that an animal waste retention structure (such as a poultry house storage area, lagoon, or wastewater treatment plant) is to be permanently taken out of operation, all wastes stored in that structure will be removed and land-applied, or otherwise properly disposed, prior to closure.

Mortality — Chickens that have become too old to be effective egg producers are removed live from the layer houses and transported to an outside contractor, who then dispatches and processes the chickens into other products. Chickens and pullets which die while still at the facility are sent to an offsite rendering facility; if this option is not available, the carcasses may be composted on site in accordance with state veterinarian standards and procedures in a way that does not adversely affect ground or surface water or create a public health concern.

Chemical Handling — No chemicals are deliberately introduced into the process wastewater or chicken litter storage areas for disposal purposes. BMPs for disposal of pesticides are discussed in the BMP plan.

Clean Water Diversion — The poultry houses which contain the manure storage areas are roofed, and the ground between each house is graded, so that clean water (rainfall or runoff) does not contact the stored chicken litter. Buildings, collection systems, conveyance systems, and storage facilities are constructed and maintained to prevent leakage of organic matter, nutrients, and pathogens to ground or surface water.

Wastewater/Solids Runoff Prevention — Wastewater and solids will be applied to land at a rate low enough to prevent runoff into waters of the Commonwealth of Kentucky.

Weather Conditions — Litter will not be applied on saturated, frozen, and/or snow-covered soil.

Restricted Animal Access to Water — Direct access of chickens to waters of the Commonwealth of Kentucky is restricted via caging. Animals are watered by an on-demand watering system installed in each cage.

Setback Criteria — Non-application buffer widths are maintained around poultry houses, litter storage/composting sites and fields receiving litter and/or process water (please see the Setback Criteria in the Cal-Maine BMP Plan).

8.0 APPLICATION EQUIPMENT OPERATION AND MAINTENANCE

8.1 Application Equipment and Procedures

Poultry manure is land-applied by an experienced operator using a Barron Brothers poultry litter spreader, broadcast type. The application rate is modified by controlling:

- The speed of the spreader.
- The web speed, which funnels the manure to the back for application.
- The swath width, determined by the hydraulic fans which distribute the manure.

The manure application rate is six tons per acre. Consistency in the application rate is maintained because litter is applied on this farm by only one operator, who has conducted manure spreading for many years. The manure application rate has been confirmed over the many years of operation of the spreader. The operator compares the manure weight and volume with the acreage covered to verify the application rate.

Manure that is placed on a field to be planted in corn is incorporated using a ripper to minimize residue disturbance. Manure applied to a field prior to planting of winter wheat or soybeans is not incorporated with a ripper, but is incorporated during crop planting.

8.2 General Land Application Requirements

Cal-Maine follows these general land-application procedures:

- If the crop, method of application, feed ration, or consistency of manure changes, an appropriate application amount will be re-calculated.

- Litter will not be spread in an established waterway or any defined drainageway that carries concentrated flow. Litter applied to newly constructed grass waterways will be incorporated immediately.

- Litter will not be applied on land that is subject to occasional or frequent flooding unless the litter is incorporated immediately.

- Any waste material generated by cleaning the application equipment is land-applied to crop land.

- Vehicles used to transport litter on state or federally maintained roads are covered when the hauling distance is greater that one mile.

- In no case will the application rate of poultry litter exceed 10 tons per acre during a single application.

Appendices

Appendix A

NRCS Conservation Practice Standard 590
Nutrient Management

NATURAL RESOURCES CONSERVATION SERVICE

CONSERVATION PRACTICE STANDARD

NUTRIENT MANAGEMENT

(Acre)

CODE 590

DEFINITION

Managing the amount, sources, placement, form and timing of the application of nutrients and soil amendments.

PURPOSES

- To budget and supply nutrients for plant production.
- To properly utilize manure or organic by-products as a plant nutrient source.
- To minimize agricultural nonpoint source pollution of surface and ground water resources.
- To maintain or improve the physical, chemical and biological condition of soil.

CONDITIONS WHERE PRACTICE APPLIES

This practice applies to all lands where plant nutrients and soil amendments are applied.

CRITERIA

General Criteria Applicable to All Purposes

Plans for nutrient management shall comply with all applicable Federal, state, and local laws and regulations.

Plans for nutrient management shall be developed in accordance with policy requirements of the NRCS General Manual Title 450, Part 401.03 (Technical Guides, Policy and Responsibilities) and Title 190, Part 402 (Ecological Sciences, Nutrient Management, Policy); technical requirements of the NRCS Field Office Technical Guide (FOTG); procedures contained in the National Planning Procedures Handbook (NPPH), and the NRCS National Agronomy Manual (NAM) Section 503.

Employees of NRCS and other persons who approve plans for nutrient management shall be certified through a certification program acceptable to NRCS in the state of Kentucky. Persons who develop (but not approve) nutrient management plans are not required to become certified. Note: Certification may be required for persons who develop nutrient management plans when regulatory permits or other special rules require technical assistance from a certified nutrient management specialist.

Plans for nutrient management that are elements of a more comprehensive conservation plan or waste management system shall recognize other requirements of the respective plan and be compatible with the other plan requirements.

A nutrient budget for nitrogen, phosphorus, and potassium shall be developed that considers all potential sources of nutrients including, but not limited to animal manure and organic by-products, waste water, commercial fertilizer, crop residues, legume credits, and irrigation water. Note: As crops, method of application, feed ration or consistency of the manure change, it will be necessary to re-calculate an appropriate nutrient application rate using a nutrient budget.

Realistic yield goals shall be established based on soil productivity information, historical yield data, climatic conditions, level of management and/or local research on similar soil, cropping systems, and soil and manure/organic by-products tests. For new crops or varieties, industry yield recommendations may be used until documented yield information is available.

Plans for nutrient management shall specify the form, source, amount, timing and method of application of nutrients on each field to achieve realistic production goals, while minimizing nitrogen and/or phosphorus movement to surface and/or ground waters.

Erosion, runoff, and water management controls shall be installed, as needed, on fields that receive nutrients.

Site/Field Risk Assessment

Evaluate each field, site, or farm for risk of vulnerability of nitrogen and phosphorus to impact water resources using available information, such as soil ratings for leaching of soluble nutrients, soil infiltration rates, geology reports, sinkhole maps, stream classification, proximity of site to wells and streams, etc.

The *Phosphorus Index for Kentucky* * and other NRCS approved assessment tools will be used as needed to assess the potential risk of phosphorus movement into water on all fields or portions of fields that will have nutrients (no sewage sludge or bio-solids) applied on them. *

Required assessment on all fields with a residual soil test P level above 400 lbs/acre. The 400 lbs/acre is based on a routine soil test that measures extractable Phosphorus as determined by the Mehlich 3 method. ***The current version of the Phosphorus Index for Kentucky can be referenced in Appendix C of this standard and in Chapter 3 of the NRCS Agricultural Waste Management Field Handbook.*** *This handbook is on file in local NRCS offices.*

When a field-specific assessment of the potential for phosphorus transport from the field is completed, the plans shall include:

- a record of the assessment rating for each field or sub-field, and
- information about conservation practices and management activities that can reduce the potential for phosphorus movement from the site.

When such assessments are done, the results of the assessment and recommendations shall be discussed with the producer during the development of the plan.

Soil Sampling and Laboratory Soil Analysis (Soil Testing)

Nutrient management planning shall be based on soil test information obtained by laboratory procedures that are in accordance with the University of Kentucky College of Agriculture (University) or industry practice if recognized by the University. Note: The University of Kentucky uses the Mehlich 3 method to measure extractable phosphorus. Refer to information that is available from the University of Kentucky for recommended soil sampling frequencies. *Note: Current soil analysis information from each field planned for nutrient applications will be needed during the development of a nutrient management plan. A current soil analysis is less than 1 year old.*

Soil samples shall be collected and prepared according to the University guidance. Note: All soil test recommendations will be made on the assumption that a representative soil sample has been properly taken from the field or area to receive the nutrient application. Soil analyses shall be performed by laboratories that belong to the North American Proficiency Testing Program (Soil Science Society of America) and whose tests are conducted consistent with laboratory test procedures as published by the University of Kentucky.

A routine soil test shall include analysis for any nutrients for which specific information is needed to develop the nutrient plan. Request analyses pertinent to monitoring or amending the annual nutrient budget, e.g. buffer pH, water pH, phosphorus, potassium, zinc, magnesium and calcium.

Plant Tissue Testing

Tissue sampling and testing, where used, shall be done in accordance with the University standards or recommendations.

Nutrient Application Rates

Recommended nutrient application rates shall be based on soil sampling laboratory analysis, nutrient analysis, plant tissue testing or other NRCS approved analysis tools. The recommendations from these analyses must consider available information obtained from current soil test results, realistic yield goals and crop management plans.

Individual nutrient recommendations will be formulated on a philosophy that considers University of Kentucky Lime and Fertilizer recommendations or crop nutrient removal potential. ***Estimated crop nutrient removal values (nutrients removed in harvested plant biomass) approved by NRCS for several key crops grown in Kentucky can be referenced in Appendix A, Table 6 of this standard.***

Excess nutrients shall not be applied in situations in which it causes unacceptable nutrient imbalances in crops or forages.

Nitrogen (N), Phosphorus (P) and Potassium (K) - The planned rates of nutrient application, as documented in the nutrient budget, shall match the recommended rates as closely as possible for all nutrients including nitrogen, phosphorus and potassium. More information about nutrient availability from certain sources, storage/application losses, and removal values can be referenced in ***Appendix A, Tables 1-6 of this standard.***

Note: The following information applies to all applied nutrients such as from commercial (mineral based) fertilizers, animal wastes and other sources:

When the soil test results indicate a level of phosphorus that is 400 lbs/acre or less, the University of Kentucky Lime and Fertilizer recommendations or NRCS approved estimated crop removal values will be used to determine application rates based on nitrogen as the limiting nutrient.

When the plan is being implemented on a nitrogen basis, manure or other organic by-products shall be applied at rates that are limited by the amount of nitrogen in the material. Credit for available nitrogen provided from cover crops and previous crop residues shall be considered in the nutrient budget. Refer to ***Appendix A, Table 4 (Estimated Nitrogen Availability To Succeeding Crops From Legumes)*** for related information.

In certain cropping situations such as involving soybeans, alfalfa and other legumes, nitrogen application may not be recommended according to the University of Kentucky Lime and Fertilizer recommendations. In these situations, manure or other organic by-products (containing nitrogen) may be applied at rates not to exceed the estimated removal of nitrogen in harvested plant biomass.

Estimated crop nutrient removal values approved by NRCS are referenced in Appendix A, Table 6

When the soil test results indicate a level of phosphorus above 400 lbs/acre, *nutrient* application rates will be determined by using one of the following options: Phosphorus Threshold (PT) or Phosphorus Index (PI).

Option 1 - Soil Test Phosphorus Threshold (PT) Values. In situations where the soil test phosphorus (STP) levels are below 400 lbs/acre, nitrogen based nutrient applications may be applied. As soil test levels increase above 400 lbs/acre, planned phosphorus application rates (from any nutrient source) shall be determined as based on estimated phosphorus removal in harvested plant biomass at levels prescribed in the phosphorus threshold. When soil test phosphorus exceeds 1066 lbs/acre no further applications of phosphorus (from any nutrient source) shall be made to the field/area.

When the Phosphorus Threshold option is utilized, the following information applies:

401-800 STP - Phosphorus applications at rates not to exceed the estimated removal of phosphorus in the harvested plant biomass.

801-1066 STP - Phosphorus applications at rates not to exceed 1/2 of the estimated removal of phosphorus in the harvested plant biomass.

(Reference the ***Phosphorus Threshold for Kentucky in Appendix C (P Matrix,Option 1) of this standard*** for more information.)

Option 2 - Phosphorus Index (PI) Rating.

Low or Medium Risk Sites - Nitrogen based nutrient application.

High and Very High Risk Sites - Phosphorus based or no nutrient application.

- In some instances the (PI) rating may be in the low or medium risk category when soil test phosphorus is above 400 lbs/acre. In these instances, nutrient application rates

based on nitrogen may be planned. University of Kentucky Lime and Fertilizer recommendations or NRCS approved estimated crop removal values for nitrogen will be used to determine nutrient application rates based on nitrogen.

- When soil test phosphorus exceeds 1066 lbs/acre no further applications of phosphorus (from any nutrient source) shall be made to the field/area.

(Reference the ***Phosphorus Index Worksheet for Kentucky in Appendix C (P Matrix,Option 2) of this standard*** for more information.)

Phosphorus Application - When phosphorus based applications are planned, the amount of nitrogen applied shall be limited according to University of Kentucky Lime and Fertilizer recommendations or NRCS approved estimated crop removal values for nitrogen. When the plan is being implemented on a phosphorus basis, manure or other organic by-products shall be applied at rates that are limited by the amount of phosphorus in the material.

A single application of phosphorus applied as manure may be made at a rate equal to the recommended phosphorus application or estimated phosphorus removal in harvested plant biomass for the crop rotation or multiple years in the crop sequence. When such applications are made, the application rate shall:

- not exceed the recommended nitrogen application rate during the year of application.
- not exceed the estimated nitrogen removal in harvested plant biomass during the year of application when there is no recommended nitrogen application.
- not be made on sites considered vulnerable to off-site phosphorus transport unless appropriate conservation practices, best management practices, or management activities are used to reduce the vulnerability.

Note: Refer to the University of Kentucky Lime and Fertilizer recommendations as a basis for applying phosphorus according to plant requirements when crop removal is not an option.

Note: When applying a phosphorus based nutrient application, an additional nitrogen application, from non-organic sources, may be required to supply the recommended amounts of nitrogen for the host crop.

Additional information about the Phosphorus Threshold and Phosphorus Index can be requested from local NRCS offices.

- **Micronutrients and Other Plant Nutrients** - The planned rates of application of micronutrients and other nutrients shall be consistent with University guidance. When manure or other organic by-products are a source of nutrients, see "Additional Criteria" as applicable, which is referenced in the next column.
- **Starter Fertilizers** - Starter fertilizers containing nitrogen, phosphorus and potassium may be applied in accordance with University recommendations. When starter fertilizers are used, they shall be included in the nutrient budget.
- **Soil Amendments and Lime** - Soil amendments shall be applied, as needed, to adjust soil pH to the specific range of the crop for optimum availability and utilization of nutrients. Application will be consistent with University guidance.

Nutrient Application Timing

Timing and method of nutrient application shall correspond as closely as possible with plant nutrient uptake characteristics, while considering cropping system limitations, weather and climatic conditions, and field accessibility. Nutrients shall generally not be applied in fields/areas with frozen, snow-covered, or saturated soils, however the following guidelines and exceptions apply:

- Mineral fertilizers (only) may be land applied on frozen soils in fields/areas within 30 days of the beginning of crop growth unless heavy precipitation is forecasted before thawing.
- Solid waste (animal manure w/bedding) applications may be land applied on frozen

soils in fields/areas unless heavy precipitation is forecasted before thawing. When solid wastes are applied on frozen soils, an application set back of at least 75 feet from streams, sinkholes and other sensitive areas is recommended. Additional federal, state and local guidelines may apply to application setbacks.

- Liquid (animal manure) waste applications shall not be applied on frozen soils. Liquid applications may be land applied in fields/areas within 30 days of the beginning of crop growth when soil conditions are favorable unless heavy precipitation is forecasted before the liquid can be absorbed into the soil profile.
- These exceptions will only apply if Best Management Practices (BMP's) are applied such as filter strips, crop residue management, vegetative cover management, application set backs and other strategies are implemented properly so as to reduce the risk of pollution.

Nutrient Application Methods

Nutrient applications associated with irrigation systems shall be applied in accordance with the requirements of Irrigation Water Management (Code 449).

Additional Criteria Applicable to Manure or Organic By-Products Applied as a Plant Nutrient Source

Animal manure applications are primarily based on plant available nutrient content. However, the volume applied (tons, gallons, cubic feet, acre-inches) on a per acre basis during each application event and the soil conditions at the time of application are also of concern. For these reasons a sound nutrient management plan must contain strategies for application that consider manure nutrient values, volume applied during each application and other site specific limitations.

Nutrient Analysis/Testing

Nutrient values of manure and organic by-products (excluding sewage and bio-solids) shall be determined (by laboratory analysis) prior to land application.

Exception: When preparing nutrient management plans on "new" animal feeding operations, (those without manure in storage), approved "book values" for estimated manure nutrient content may be used as a basis for planning application rates until a manure analysis can be obtained. Approved "book values" are those recognized by the NRCS and the University. ***Approved book values for animal manures recognized by NRCS and the University can be referenced in Appendix A, Tables 1,2,3,5 of this standard.***

When an analysis of the manure is available, an application amount can be determined using known nutrient values at the time of application. Testing of the manure shall include an analysis for total nitrogen and total phosphorus. The analysis results can be converted to pounds of nutrients per ton for solids and/or pounds of nutrients per 1000 gallons for liquids. Note: Once historical laboratory manure analysis data is established, annual analysis is not required unless operational changes occur with manure storage facilities, storage intervals, feed rations and other situations.

Recommended procedures for collecting and preparing manure samples can be referenced in ***Appendix B of this standard.***

Manure Nutrients: Application Rate Limitations

The application rate (in/hr) for material applied through irrigation shall not exceed the soil intake/infiltration rate. The total application shall not exceed the field capacity of the soil.

The planned rates of manure or organic by-products applied as a source of plant available nitrogen and phosphorus shall be determined based on guidance as outlined in following sections. More information about manure nutrient application rates can be referenced in Chapter 3 of the NRCS Agricultural Waste Management Field Handbook.

Estimated ***crop nutrient removal values approved by NRCS can be referenced in Appendix A, Table 6*** of this standard.

Manure Volume - Expected Land Application Rates of Manure Based on Volume Limitations

The plant available nutrient amounts in manure can vary due to time in storage, storage methods, ration content and other reasons. With this in mind, certain manures may contain low amounts of nutrients. If these types of manure are applied at rates according to potential crop uptake, utilization and removal, large volumes may be applied during each application event. These excessively large volumes of applied manures may increase the risk of movement offsite and/or cause a buildup of toxic compounds in the soil. For these reasons the following volume limitations will apply for all manure applications in Kentucky:

Volume Limitations

Solids - maximum 10 tons/application (or)
Liquids – maximum ½ inch/acre/application (maximum 56 tons/acre/application).

Note: Volume limitations (as quoted above) are based on adequate field conditions present at the time of application. Further information concerning recommended field conditions can be referenced in subsequent sections of this standard. Certain crops such as tobacco may be sensitive to excessive nutrient and chemical loading that could occur with high annual volumes of applied animal waste.

Note: A unit conversion table can be referenced in *Appendix D of this standard.*

Heavy Metals Monitoring

When sewage sludge is applied, the accumulation of potential pollutants (including arsenic, cadmium, copper, lead, mercury, selenium, and zinc) in the soil shall be monitored in accordance with the US Code, Reference 40 CFR, Parts 403 and 503, and/or any applicable state/local laws or regulations.

Additional Criteria to Minimize Agricultural Non-point Source Pollution of Surface and Ground Water Resources

Nutrient applications at any time must be managed in consideration of soil moisture content, rainfall expectations, land slope and other adequate field conditions.

Additional awareness must also be given to manure applications within proximity to streams, sinkholes, waterbodies, wetlands and other sensitive landscape features. Application rates, methods and timing will need to be considered prior to manure applications (in each field) in order to prevent pollutant discharge.

Plans developed to minimize agricultural nonpoint source pollution of surface or ground water resources shall include practices and/or management activities that can reduce the risk of nitrogen or phosphorus movement from the field.

Additional Criteria to Improve the Physical, Chemical, and Biological Condition of the Soil.

Nutrients shall be applied in such a manner as not to degrade the soil's structure, chemical properties, or biological condition. Use of nutrient sources with high salt content will be minimized unless provisions are used to leach salts below the crop root zone.

Nutrients shall not be applied to flooded or saturated soils when the potential for soil compaction and creation of ruts is high.

CONSIDERATIONS

Consider induced deficiencies of nutrients due to excessive levels of other nutrients.

Consider additional practices such as Conservation Cover (327), Grassed Waterway (412), Contour Buffer Strips (332), Filter Strips (393), Irrigation Water Management (449), Riparian Forest Buffer (391A), Conservation Crop Rotation (328), Cover and Green Manure (340), and Residue Management (329A, 329B, or 329C, and 344) to improve soil nutrient and water storage, infiltration, aeration, tilth, diversity of soil organisms and to protect or improve water quality.

Consider cover crops whenever possible to utilize and recycle residual nitrogen.

Consider application methods and timing that reduce the risk of nutrients being transported to ground and surface waters, or into the atmosphere. Suggestions include:

- split applications of nitrogen to provide nutrients at the times of maximum crop utilization,
- avoiding winter nutrient application for spring seeded crops unless nutrient availability to the crops can be timed with subsequent emergence and growth,
- band applications of phosphorus near the seed row,
- applying nutrient materials uniformly to application areas or as prescribed by precision agricultural techniques, and/or
- immediate incorporation of land applied manures or organic by-products,
- delaying field application of animal manures or other organic by-products if precipitation capable of producing runoff and erosion is forecast within 24 hours of the time of the planned application.

Consider minimum application setback distances from environmentally sensitive areas, such as sinkholes, wells, gullies, ditches, surface inlets or rapidly permeable soil areas.

Consider the potential problems from odors associated with the land application of animal manures, especially when applied near or upwind of residences.

Consider nitrogen volatilization losses associated with the land application of animal manures. Volatilization losses can become significant if manure is not immediately incorporated into the soil after application.

Consider the potential to affect listed or eligible cultural resources in the State or National Register.

Consider using soil test information no older than one year when developing new plans, particularly if animal manures are to be a nutrient source.

Consider annual reviews to determine if changes in the nutrient budget are desirable (or needed) for the next planned crop.

On sites on which there are special environmental concerns, consider other sampling techniques. (For example: Soil profile sampling for nitrogen, Pre-Sidedress Nitrogen Test (PSNT), Pre-Plant Soil Nitrate Test (PPSN) or soil surface sampling for phosphorus accumulation or pH changes.)

Consider ways to modify the chemistry of animal manure, including modification of the animal's diet to reduce the manure nutrient content and to enhance the producer's ability to manage manure effectively.

PLANS AND SPECIFICATIONS

Plans and specifications shall be in keeping with this standard and shall describe the requirements for applying the practice to achieve its intended purpose(s), using nutrients to achieve production goals and to prevent or minimize water quality impairment.

The following components shall be included in the nutrient management plan:

- aerial photograph or map and a soil map of the site,
- current and/or planned plant production sequence or crop rotation,
- results of soil, plant, water, manure or organic by-product sample analyses,
- realistic yield goals for the crops in the rotation,
- quantification of all nutrient sources,
- recommended nutrient rates, timing, form, and method of application and incorporation,
- location of designated sensitive areas or resources and the associated, nutrient management restriction,
- guidance for implementation, operation, maintenance, record keeping, and
- complete nutrient budget for nitrogen, phosphorus, and potassium for the rotation or crop sequence.

If increases in soil phosphorus levels are expected, plans shall document:

- the soil phosphorus levels at which it may be desirable to convert to phosphorus based implementation,
- the relationship between soil phosphorus levels and potential for phosphorus transport from the field, and
- the potential for soil phosphorus drawdown from the production and harvesting of crops.

When applicable, plans shall include other practices or management activities as determined by specific regulation, program requirements, or producer goals.

In addition to the requirements described above, plans for nutrient management shall also include:

- discussion about the relationship between nitrogen and phosphorus transport and water quality impairment. The discussion about nitrogen should include information about nitrogen leaching into shallow ground water and potential health impacts. The discussion about phosphorus should include information about phosphorus accumulation in the soil, the increased potential for phosphorus transport in soluble form, and the types of water quality impairment that could result from phosphorus movement into surface waters.
- discussion about how the plan is intended to prevent the nutrients (nitrogen and phosphorus) supplied for production purposes from contributing to water quality impairment.
- a statement that the plan was developed based on the requirements of the current standard and any applicable Federal, state, or local regulations or policies; and that changes in any of these requirements may necessitate a revision of the plan.

OPERATION AND MAINTENANCE

The owner/client is responsible for safe operation and maintenance of the nutrient management plan including all equipment.

Operation and maintenance addresses the following:

- periodic plan review to determine if adjustments or modifications to the plan are needed. As a minimum, plans will be reviewed/revised with each soil test cycle.
- protection of fertilizer and organic by-product storage facilities from weather and accidental leakage or spillage.
- calibration of application equipment to ensure uniform distribution of material at planned rates.
- documentation of the actual rate at which nutrients were applied. When the actual rates used differ from or exceed the recommended and planned rates, records will indicate the reasons for the differences.
- Maintaining records to document plan implementation. As applicable, records include:
  - soil test results and recommendations for nutrient application,
  - quantities, analyses and sources of nutrients applied,
  - dates and method of nutrient applications,
  - crops planted, planting and harvest dates, yields, and residues removed,
  - results of water, plant, and organic by-product analyses, and
  - dates of review and person performing the review, and recommendations.

Records should be maintained for five years or for a period longer than five years if required by other Federal, state, or local ordinances, or program or contract requirements.

Workers shall be protected from and avoid unnecessary contact with chemical fertilizers and organic by-products. Protection should include the use of protective clothing when working with plant nutrients. Extra caution must be taken when handling ammonia sources of nutrients, or when dealing with organic wastes stored in unventilated enclosures.

The disposal of material generated by the cleaning nutrient application equipment should

be accomplished properly. Excess material should be collected and stored or field applied in an appropriate manner. Excess material should not be applied on areas of high potential risk for runoff and leaching.

The disposal/recycling of nutrient containers should be according to state and local guidelines or regulations.

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APPENDICIES

Kentucky NRCS Nutrient Management Standard 590

Appendix A

Table 1 - Manure and Nutrients As Excreted Per 1000-lb. Live Weight/Day

Table 2 - Percent of Original Nutrient Content of Manure Retained by Various Management Systems

Table 3 - Percent of Nutrients from Manure Available to a Crop During the Year of Application in Comparison with Fertilizer Nutrients (Based On Application Conditions)

Table 4 - Estimated Nitrogen Availability to Succeeding Crops from Legumes

Table 5 - Estimates of Available Nitrogen from Manure Application in Previous Year

Table 6 - Crop Nutrient Removal Values

Appendix B

Manure Sampling Procedures

Appendix C

Kentucky Phosphorus (P) - Matrix

Kentucky Phosphorus (P) - Index

Appendix D

Unit Conversion Table

APPENDIX A

Table 1 - Manure and Nutrients As Excreted Per 1000-lb. Live Weight/Day

Animal Type	Volume of Manure (cu.ft.) 1/	Dry Matter Manure (lbs)	Total Nitrogen (lbs)	Total P as P_2O_5 (lbs)	Total K as K_2O (lbs)
Beef (all cattle and calves) 2/	1.0	8.5	.34	.21	.25
Dairy Cows 2/	1.32	12.0	.45	.21	.35
Dairy Heifers 2/	1.30	12.0	.45	.21	.35
Swine – Lactating Sows w/litters 2/	.96	11.0	.52	.41	.35
Swine – Gestating Sows, Boars, Gilts 2/	.50	5.5	.26	.20	.17
Swine – Nursery and Finishing Pigs 2/	1.70	11.0	.52	.41	.35
Poultry Litter - Layer 2/	.93	16.0	.84	.69	.36
Poultry Litter - Breeder Layer 2/	.93	16.0	.84	.69	.36
Poultry Litter - Pullet 3/	.73	11.4	.62	.55	.31
Poultry Litter - Breeder Pullet /3	.73	11.4	.62	.55	.31
Poultry Litter - Broiler 2/	1.26	22.0	1.10	.69	.48
Horses 3/	.80	11	.28	.11	.23
Sheep and Lambs 3/	.62	10	.45	.16	.36

1/ Poultry litter weighs about 27 lbs/cu ft (considering bedding).
Swine, dairy, beef , horses and sheep waste (solids) weighs about 60 lbs/cu ft.
Liquids weigh about 62.4 lbs/cu ft.

2/ Adapted from 1993 ASAE Standards. Reference: University of Kentucky (IP-57) *Potential for Livestock and Poultry Manure to Provide the Nutrients Removed by Crops and Forages in Kentucky*, Issued 9-1999

3/ Adapted from 1992 NRCS Agricultural Waste Management Field Handbook.

Table 2 - Percent of Original Nutrient Content of Manure Retained by Various Management Systems 1/ (This table will be used for estimation purposes when results from a laboratory analysis are unknown at the time of land application). When laboratory analysis results are known, proceed to Table 3.

	Beef			Dairy			Poultry			Swine		
Management System	N	P	K	N	P	K	N	P	K	N	P	K
Manure stored in open lot (cool humid region)	70	80	70	85	95	95				70	80	70
Manure liquids and solids stored in a covered essentially watertight structure	85	95	95	85	95	95				85	95	95
Manure liquids and solids stored in an uncovered essentially watertight structure	75	90	90	75	90	90				75	90	90
Manure liquids and solids (diluted less than 50%) held in waste storage pond	80	95	95	80	95	95				80	95	95
Manure and bedding held in roofed storage	80	95	95	80	95	95	70	95	95			
Manure and bedding held in unroofed storage leachate lost	75	85	85	75	85	85						
Manure stored in pits beneath slatted floor	85	95	95	85	95	95	90	95	95	85	95	95
Manure treated in anaerobic lagoon or stored in waste storage pond after being diluted more than 50%	35	50	65	35	50	65	30	50	60	30	50	60

1/ Adapted from 1992 NRCS Agricultural Waste Management Field Handbook.

Table 3 - Percent of Nutrients from Manure Available to a Crop During the Year of Application in Comparison with Fertilizer Nutrients (Based On Application Conditions) 1/

Nutrient	Availability Coefficient	
	Poultry or Liquid	Other Manures
Nitrogen		
Corn & Others: Corn, Tobacco, Annual Grasses or Sorghum		
Spring Applied		
Incorporation: 2 days or less	0.60	0.50
Incorporation: 3-4 days	0.55	0.45
Incorporation: 5-6 days	0.50	0.40
Incorporation: 7 days or more	0.45	0.35
Fall Applied		
w/o cover crop	0.15	0.20
w/ cover crop	0.50	0.40
Small Grains (pre-plant)	0.50	0.40
Pasture (Fall or early Spring)	0.80	0.60
Phosphate	0.80	0.80
Potash	1.00	1.00

1/ Note: Information from Table 2 or from a laboratory analysis will be used as a basis for Table 3.
Table 3 Source: AGR-146 "Using Animal Manures as Nutrient Sources" 8/2000 University of KY

Table 4 - Estimated Nitrogen Availability to Succeeding Crops from Legumes 1/

Crop	Description	Residual N (lb/ac)
Alfalfa or Red Clover	Good Stand (> 4 tons/ac)	90
	Fair Stand (3 to 4 tons/ac)	70
	Poor Stand (< 3 tons/ac)	50
Hairy Vetch	Good	100
	Fair	75
	Poor	50
Soybeans		½ lb per bushel or 20 lbs/ac if not known

1/ Table 4 will be used to calculate the nitrogen credits (when legumes are grown prior to the present crop) in the nutrient budget. Nitrogen credits will be considered in estimating crop removal when it is used as a basis for planning nitrogen applications. When the nitrogen application is based on University of Kentucky Lime and Fertilizer Recommendations, estimated available nitrogen from previous crops will be considered in the recommendation.

Table 5 - Estimates of Available Nitrogen from Manure Application in a Previous Year 1/ 2/

Frequency of Manure Applications	Manure Type (N availability coefficients**)	
	Poultry or Liquids	Other
Less than 4 out of 10 years	0.03	0.05
4-8 out of ten years	0.07	0.15
More than 8 out of ten years	0.12	0.25

1/ From D.B. Beegle, Penn State University. **Percentage of total Nitrogen applied last year.
2/ Table 5 will be used to calculate the nitrogen credits (when manure is applied in years prior prior to the present crop) in the nutrient budget. Nitrogen credits will be considered in estimating crop removal when it is used as a basis for planning nitrogen applications. When the nitrogen application is based on University of Kentucky Lime and Fertilizer Recommendations, estimated available nitrogen from previous crops and manure/fertilizer applications will be considered in the recommendation.

Table 6 - Crop Nutrient Removal Values*

Crop	Nutrients Removed (lbs/yield unit)				
	Yield Unit	Lbs per Yield Unit	Total Kjeldahl Nitrogen	P_2O_5	K_2O
Alfalfa hay [1/]	Ton	2000	50	14	55
All other cool season grass/legume hay (except alfalfa) [1/]	Ton	2000	35	12	53
Rye for grain [2/]	Bushel	56	1.16	.33	.32
Oats for grain [2/]	Bushel	32	.62	.25	.19
Barley for grain [2/]	Bushel	48	0.90	0.41	0.30
Corn for grain [1/]	Bushel	56	0.70	0.40	0.35
Corn for silage or green chop [1/]	Ton	2000	7.5	3.6	8.0
Winter wheat for grain [1/]	Bushel	60	1.20	0.50	0.30
Sorghum for grain 1/	Bushel	56	0.95	0.41	0.30
Soybean for beans [1/]	Bushel	60	3.00	0.70	1.10
Tobacco, burley [1/]	Pound	1	0.07	0.011	0.075
Tobacco, dark air-cured [1/]	Pound	1	0.07	0.006	0.06
Tobacco, dark fire-cured [1/]	Pound	1	0.07	0.006	0.06
Forage from pastureland [3/]	Ton	2000			
Big Bluestem, Indiangrass, Little Bluestem, Switchgrass [4/] hay	Ton	2000	20	6.8	25
Bermudagrass [4/] hay	Ton	2000	37.6	8.7	33.6
Reed Canary Grass [4/] hay	Ton	2000	27	8.2	25
Eastern Gamagrass hay	Ton	2000	35	16.1	31.2

*/ Nutrient removal values for crops and forages referenced n the NRCS Nutrient Management Standard 590.

[1/] Assessment of the Potential for Livestock and Poultry Manure to Provide the Nutrients Removed by Crops and Forages in Kentucky. IP-56) 1999 University of Kentucky, Lexington Kentucky Table 5 Adapted from Wells and Thom (1994) and Lander et al. (1998). University of KY AGR-1.

[2/] Estimated Crop Nutrient Removal Values according to NRCS's Agricultural Waste Management Field Handbook, Chapter 6 when harvested as a hay crop.

[3/] Nutrient removal for forage from pastureland estimated as 30% of the values given for all grass/legume species harvested as hay (except alfalfa).

[4/] Reid, R. L., G. A. Jung, and D. W. Allinson, 1988. *"Nutritive Quality of Warm Season Grasses in the Northeast"*. Bulletin 699, West Virginia University, College of Agriculture and Forestry

[5/] Jung, G. A., Schaffer, J. A., Stout, W. L., *"Switchgrass and Big Bluestem Responses to Amendments on Strongly Acid Soils"*. Agronomy Journal 80:669-676.

Note: Table 6 will be used to calculate crop nutrient removal potentials in the nutrient budget. When the nutrient management plan is based on the amount of nitrogen applied (in consideration of crop removal), estimated available nitrogen from previous crops and manure/fertilizer applications (Tables 4 and 5) will be considered. However, University of Kentucky Lime and Fertilizer Recommendations will be utilized as the basis for planning nutrient applications unless crop removal is used. When University of Kentucky Lime and Fertilizer recommendations are used, estimated available nitrogen from previous crops and manure/fertilizer applications will be considered in the recommendation.

APPENDIX B

MANURE SAMPLING PROCEDURES

For laboratory testing, manure can be handled as a solid, semi-solid, or liquid. Semi-solid manure usually requires thorough agitation before pumping and sampling.

When to Sample

Sample manure as close to the time of land application as possible. Sampling at the time of application will not provide manure recommendations that can be used to adjust the amount of manure applied. However, the results can be used to adjust the amount of inorganic fertilizer applied and can also be used at the next application event. If you apply manure several times a year, sample when you apply the bulk of the manure. Ideally, manure sampling should be done in the field as manure is applied. This ensures that losses that occur during handling, storage, and application are taken into account.

Manure Sampling in the Field

Dry or Solid Field Sampling. To sample manure from barns, holding areas, dry stacks, or feed lots, collect a sample as follows:
Use the "hand and bag" method to collect all solid manure samples. Place a one-gallon re-sealable freezer bag turned inside out over one hand. Grab a handful of manure with covered hand and turn the freezer bag right side out over the sample with the free hand. Seal the bag and place it in another freezer bag to prevent leaks. Label the bag and send to the lab or freeze it immediately to prevent nutrient losses. Take three samples for dry or solid manure. Combine the samples and mix. Place in zip-lock bag.

Liquid Manure Sampling

When sampling liquid manure agitate the manure in the storage facility to obtain a representative sample for laboratory analysis.

Liquid Manure Applied with Spreaders

1. Immediately after filling the tank spreader, use a clean plastic bucket to collect manure from the unloading port or the opening near the bottom of the tank. Be sure the opening does not have solids accumulated that can contaminate the samples.
2. Stir the manure in the pail and immediately fill a one-quart flexible plastic bottle about 25 percent full. Do not use a glass bottle as it might explode from pressure build-up. Squeeze as much air out of the bottle as possible before capping.
3. Put your name, date and sample number on the bottle and the information sheet.
4. If the sample cannot be sent to the laboratory within a few hours, it should be refrigerated. Place the sample in a plastic bag, seal the bag, and keep cool until it is sent to the laboratory. Ship so that the sample arrives promptly at the laboratory.

Liquid Manure Applied by Irrigation Systems

1. Place catch pans or buckets randomly in the field to collect the liquid manure that is applied by an irrigation system.
2. Immediately after the manure has been applied, collect the manure from each pan or bucket and combine in one bucket to make a composite sample.
3. Mix the manure and fill a one-quart flexible plastic bottle about 25 percent full. Seal and label the bottle and seal in a plastic bag. If the sample cannot be shipped to the laboratory right away, keep refrigerated. Ship to arrive promptly in the laboratory.

Dry or Solid Manure Sampling

Paved Lots

1. Collect manure by scraping a shovel across 25 feet of paved feedlot. Repeat this process six to eight times. Avoid samples from areas that are very wet or contain large amounts of feed or hay.
2. Use the shovel to thoroughly mix manure by scooping the outside of the pile to the center of the pile.
3. Collect a sample using the "hand and bag" method described in the section on dry or solid field sampling.

Barn Gutter

1. Shovel a manure sample to the depth of the gutter from the gutter.
2. Remove the manure from the gutter and place it on the barn floor. Mix the sample by hand (wearing freezer bags) with a kneading motion. When collecting samples from a gutter, be sure to include the liquid that is in the bottom of the gutter.
3. Collect a sample using the "hand and bag" method.
4. Repeat steps one through three from other locations in the gutter to collect three sub samples. Combine the sub samples and mix. Place in zip-lock bag and squeeze out all of the air before closing.

Dry Stack

This is manure stored outside in a stacking shed or above ground solid waste storage facility.

1. Using a pitchfork or shovel, take manure from several locations throughout the dry stack and place it in a pile. Collect samples from the outside/center of stack.
2. Mix the manure with a shovel by scooping the outside of the pile to the center of the pile.
3. Collect a sample by the "hand and bag" method.

Repeat steps one through three to collect the three sub samples. Combine the sub samples and mix. Place in a zip-lock bag and squeeze out all of the air before closing.

Shipping

Samples should be shipped express mail to the lab the same day they are collected. If not, they should be refrigerated immediately. It is advisable to keep samples on ice even during shipment to the laboratory.

LITTER SAMPLING PROCEDURES

All litter is not managed the same way. Nutrient content can vary considerably. Every poultry producer should have his or her litter analyzed for nutrient content. If the litter is fed to cattle, an analysis is critical. Litter is fed to cattle for crude protein and ash content. Litter with a crude protein content of 28 percent and an ash content less than 15 percent is ideal for feeding. Since calcium, phosphorus, potassium and trace minerals make up about 12 percent of the ash content, anything above that amount is probably soil. Since soil is worthless for feed, care must be taken when removing litter from the houses.

Sample Collection

General Sampling. Several small samples should be collected in clean 5 gallon buckets. Mix the contents of the 5 gallon buckets for a composite sample. Place a one-gallon resealable freezer bag turned inside out over one hand. Grab a handful of manure with covered hand and turn the freezer bag right side out over the sample with the free hand. Seal the bag and place it in another freezer bag to prevent leaks. Label the bag and send to the lab or freeze it immediately to prevent nutrient losses. Label the bags with permanent marker as follows:

1. Name
2. Address
3. Type of chicken
4. Number of flocks representing the sample
5. House number
6. Method of sampling (in-house, from stack, during loading, in-field)

As a precautionary measure include the same information on a 3 by 5 card and place inside the outside freezer bag.

Other Methods of Sampling

In-House: Ten to 15 samples are collected throughout the house before cleanout. Three to four samples should be collected under or near the waterers and the rest collected throughout the remainder of the house. Dig only as deeply as you plan to scrape. Be careful not to include any soil in the sample. This method of sampling will allow reports back before land application so that an appropriate land application amount can be determined. This method is labor intensive.

During cleanout. Samples are collected as litter is loaded onto the spreader or as it is temporarily stockpiled prior to spreading. Individual samples should be collected throughout the cleanout. This method of sampling will not allow time for lab results return before land application occurs. This method will reflect an analysis of what is actually scraped out of the houses.

During spreading. A plastic sheet or gallon plastic jugs cut in half are placed in the field to collect litter as it is spread. This method is most accurate. This method will not allow time for lab results to be returned in time. However, results can be used the following application event.

Stockpile. Litter stored for a period of time is subject to heat and this can change its chemical characteristics. Since temperatures will peak in 10 to 20 days after initial stacking, samples should be collected after the temperature drops and as close to spreading or feedings time as possible. Individual samples should be collected at several points as with the general sampling procedures. Make sure to dig into the stack 2 to 3 feet for representative sample.

Shipping

Samples should be shipped express mail to the lab the same day they are collected. If not, they should be refrigerated immediately. It is advisable to keep samples on ice even during shipment to the lab.

APPENDIX C

KENTUCKY PHOSPHORUS (P) MATRIX

COMMERCIAL FERTILIZERS, ANIMAL MANURES AND ORGANIC BY-PRODUCTS

OPTION 1 *

Kentucky Environmentally Sensitive Soil Test Phosphorus Threshold (PT)
(PT) = 533 lbs (P) per Acre
Soil Test Phosphorus = (STP)

(OR)

OPTION 2 *

Kentucky Phosphorus Index Rating

Below ¾ PT
(Below 400 STP) – (N) Based

Above ¾ and Below 1-1/2 Times PT
(400-800 STP) – (P) Crop Removal

Above 1-1/2 and Below 2 Times PT
(801-1066 STP) – (P) ½ Crop Removal

Above 2 Times PT
(Above 1066 STP – No Application

Low Risk – (N) Based

Medium Risk – (N) Based

High Risk – (P) Based
(Crop Removal)

Very High Risk – (P) Based
(No Application)

**Note: A nitrogen (N) based plan can be implemented when STP is below 400. When STP is equal to or greater than 400, the use of either Option 1 or Option 2 is required in all cases.*

NUTRIENT MANAGEMENT PLANNING USING A PHOSPHORUS INDEX

A Planning Tool to Assess & Manage Phosphorus in Kentucky As Part of a Nutrient Management Plan On Agricultural Lands

The Phosphorus (P) Index is one of two options available when (P) is to be considered as a basis for nutrient management plans when nutrients will be land applied. Specific guidance about the use of each of the options can be referenced in the Kentucky NRCS technical standard for Nutrient Management (590). All nutrient management plans will consider the land application of commercial fertilizers and animal manures/wastes as sources of plant available crop nutrients. These plans will require the use of soil and manure laboratory analysis to determine the level of (P) in the soil and in the manure in order to balance land applications according to crop removal. All laboratory analysis for soil and manure will be conducted according to procedures as established by the University of Kentucky soil testing laboratory. NRCS Nutrient Management plans will be applied based on the consideration that effective erosion control practices are being applied on the fields receiving nutrient applications.

The Phosphorus Index method considers conditions which affect movement of phosphorus to streams and other waterbodies. These conditions include the hydrologic characteristics of the soil, type of cover on the soil, field slope, amount of P in the soil, presence of vegetative buffers, application rate, time of application, and method of application etc. The P Index is intended to be used as an assessment tool to indicate the potential movement of P on the landscape by taking into account various transport and source factors. Once the potential impact of P is realized, the P Index can be used to develop a nutrient management plan with acceptable application rates and best management practices. ***If the P Index indicates that a low or medium risk situation is present for the field planned for land application, the nutrient management plan may be developed with either a Nitrogen (N) or Phosphorus (P) basis.***

The ultimate goal is to promote effective utilization of nutrients, specifically from organic sources, and at the same time maintain agricultural profitability and environmental quality. ***The P Index is not intended to place any restrictions on landuse or other regulatory purposes that could be construed by manipulating index parameters.***

The (P) Index is not applicable to the planning and application of human septage sludge. When planning the application of septage and sewage sludge refer to Kentucky regulations for guidance.

PHOSPHORUS AND THE ENVIRONMENT

In Kentucky, as in many other states, large inputs of P to agricultural fields may occur. Unlike commercial fertilizers which can be delivered in quantities as recommended by a soil test report, the amount of nutrients available to plants in animal manure or other organic byproducts can vary significantly. Plant needs for phosphorus are in most cases less than nitrogen, however, essentially equal amounts of these nutrients are available to plants from manure and waste water produced at animal feeding operations. When nitrogen plant needs are met from the application of manure, P is usually over-applied. Continuous applications at these rates can present environmental concerns.

DESCRIPTION

The Kentucky P Index uses ten specific field features to obtain an overall rating for each field. Assigned to each of the field features are ***weighted factors*** of 1, 2, or 3. Not all field features have the same influence and input because research has shown that relative differences exist in their importance to P loss. Also assigned to each of the ten features are ***value ratings*** of LOW (1 point), MEDIUM (2 points), HIGH (4 points), or VERY HIGH (8 points). Multiplying the ***weighted factor*** by the appropriate ***value rating*** yields points for that specific field feature. Based on a summation of the field feature points, the field falls into an overall category rating of LOW, MEDIUM, HIGH, or VERY HIGH. If a field receives an overall rating of HIGH or VERY HIGH, management practices may be implemented to reduce the rating to MEDIUM.

KENTUCKY P INDEX WORKSHEET

Farm:		Date:
Tract:		

		FIELD FEATURE VALUE RATINGS (1, 2, 4, or 8 points)							
		Field #:_____ Acres:_____				Field #: _____ Acres:_____			
FIELD FEATURES	WEIGHTED FACTOR (WF)	Existing value	WF x Existing value	Planned value	WF x Planned value	Existing value	WF x Existing value	Planned value	WF x Planned value
1. Hydrologic Soil Group	1								
2. Residual Soil Test (P)	3								
3. Field Slope Percent	1								
4. Land Cover Percent	3								
5. Vegetative Buffer Width	3								
6. Ag. Impaired Watershed	1								
7. Application Timing	3								
8. Application Method	3								
9. Distance To Waterbody	2								
10. MLRA Location	1								
Field Features Index Totals		Existing Total*		Planned Total		Existing Total*		Planned Total	

*NOTE: If ***existing total*** results in a "Low" or "Medium" rating as indicated below, a nitrogen or phosphorus based nutrient management plan may be implemented.

Point Total	Potential for P movement
< 30	**LOW** potential for P movement from the field. There is a low probability of an adverse impact to waterbodies.
30 - 60	**MEDIUM** potential for P movement from the field. The chance of organic material and nutrients getting into waterbodies exists. Buffers, setbacks, lower manure rates, cover crops, crop residue practices alone or in combination may reduce impact.
61 - 112	**HIGH** potential for P movement from the field. The chance of organic material and nutrients getting to waterbodies is likely. Buffers, setbacks, lower manure rates, cover crops, crop residues, etc. in combination may reduce impact.
> 112	**VERY HIGH** potential for P movement from the field and an adverse impact on waterbodies.

Field Features and Weighted Factors Used in the P Index	
Field Features	Weighted Factor
1. Hydrologic Soil Group	1
2. Residual Soil Test (P) Level	3
3. Field Slope Percent	1
4. Land Cover Percent	3
5. Vegetative Buffer Width	3
6. Agricultural Impaired Watershed	1
7. Application Timing	3
8. Application Method	3
9. Distance To Spring/Stream/Waterbody	2
10. MLRA (County Location)	1

Currently, these weighted factors are based on the professional judgment of the various technical specialists who contributed to the development of the NRCS standard (590). As more research becomes available, the P Index will be periodically reviewed and updated.

Description of Field Features and Rating Assignments

1. ***Hydrologic Soil Group*** (HSG) considers the drainability of the soil. A soil with a HSG of "A" is well drained. A soil with a HSG of "D" is poorly drained. A soil that is poorly drained is more likely to have runoff occur. HSG is given a weighted factor of 1.

2. ***Residual Soil Test (P)*** considers the level of (P) in the soil prior to the application of nutrients. This level is determined by a current soil test analysis. A current soil test analysis is less than 1 year old. As soil test levels increase following repeated applications, the index points will need to be recalculated. Soil test (P) is given a weighed factor of 3.

3. ***Field Slope*** **Percent** considers the average percent of slope for the field. Field slope is given a low weighted factor of 1 because it is considered in the Erosion Rate.

4. ***Land Cover Percent*** considers the percent ground cover (average over the field) immediately following the waste application. The waste application may be surface applied, injected or incorporated. Ground cover is considered to be perennial sod or crop stubble that is evenly spread over the soil surface of the application field/s. Perennial sod shall have a minimum of 3-4 inches of plant height. Land cover is given a low weighted factor of 3 because it is also considered in the application of erosion control practices.

5. ***Vegetative Buffer Width*** considers the filtering effect of vegetative buffers at downstream edges of fields. Filtering effect must be from sheet flow across the buffer. Filter strips, field borders, contour buffer strips, and riparian forest buffers are all examples of vegetative buffers. Due to the vast amount of favorable research that reinforces the effectiveness of buffers, this feature is given a weighted factor of 3.

6. ***Application Area Is In A Watershed Identified As Being Impaired Due To Agricultural Applied Nutrients.*** These areas are identified on state supplied listings. If the application fields are in the watersheds as identified on the list currently on file in NRCS offices a weighted factor of 1 is assigned.

7. ***Application Timing*** considers historical weather data for periods where most rainfall occurs and the active growing period for crops in Kentucky. The months where most rain occurs may also be the time when crops are inactive. ***NOTE: Applications in flood prone areas shall be made with extreme caution.*** Based on these conditions, this feature is given a weighted factor of 3.

8. ***Application Method*** considers the risk for P movement based how it is applied to the field, whether it is surface applied or incorporated. This field feature is given a weighted factor of 3.

9. ***Downstream Distance To A Spring, Stream or Other Waterbody*** as measured from the closest upstream distance from the point of nutrient application in the field. This field feature is given a weighted factor of 2.

10. ***Major Land Resource Area (MLRA) refers to the county location of the fields where nutrients will be applied in consideration of documented soil and geological relationships.*** This field feature is given a weighted factor of 1.

Kentucky Phosphorus Index

Multiplying the weighted factor by the value rating, yields points for that specific field feature.

Field Features (weighted factors in parenthesis below)	Field Feature Value Ratings			
	Low (1 point)	Medium (2 points)	High (4 points)	Very High (8 points)
1. Hydrologic Soil Group (1.0)	A	B	C	D
2. Residual Soil Test (P) Level (3.0)	Between 400-500	Between 501-800	Between 801-1066	Above 1066*
3. Field Slope Percent (1.0)	<2	2-5	6-12	>12
4. Land Cover Percent* (3.0) *estimated after application	60-90	30-60	15-30	0-15
5. Vegetative Buffer Width (3.0) (ft)	>29	20-29	10-19	<10 or No Buffer
6. Application Area Is In A Watershed Identified As Being Impaired Due To Agricultural Applied Nutrients (1.0))	NO			YES
7. Application Timing (3.0)	June - Sept	April, May, Oct., March or Nov. w/ winter cover	March or Nov. w/o winter cover, Feb. w/ winter cover	Dec., Jan., Feb.
8. Application Method (3.0)	Injected	Surface applied and incorporated within 48 hr.	Surface applied and incorporated within 1 month	Surface applied and unincorporated for greater than 1 month
9. Downstream Distance From Application Area To Spring, Stream or Waterbody (2.0)	Over 150	50-150	0-50	Adjacent
10. MLRA (County Location) (1.0)	Bluegrass	All Other		

- ***Additional Phosphorus Will Not be Applied When Soil Test (P) Level is above 1066.***

Field Vulnerability for Phosphorus Loss	
Total Points from P Index	Generalized Interpretation of P Index
< 30	LOW potential for P movement from the field. Low probability of an adverse impact to waterbodies.
30 - 60	MEDIUM potential for P movement from the field. The chance of organic material and nutrients getting into waterbodies exists. Buffers, setbacks, lower manure rates, cover crops, crop residue practices alone or in combination may reduce impact.
61 - 112	HIGH potential for P movement from the field. The chance of organic material and nutrients getting to waterbodies is likely. Buffers, setbacks, lower manure rates, cover crops, crop residues, etc. in combination may reduce impact.
> 112	VERY HIGH potential for P movement from the field and an adverse impact on waterbodies.

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APPENDIX D

UNIT CONVERSION TABLE

unit for solid manure = Ton
unit for liquid manure = 1000 gal or acre inch

P (elemental phosphorus) x 2.29 = P205 (phosphorus)
K (elemental potassium) x 1.2 = K20 (potash)

percent (%) x 20 = pounds per ton
percent (%) x 80 = pounds per 1000 gallons
percent (%) x 2254 = pounds per acre-inch

mg/L x 0.002 = pounds per ton
mg/L x 0.008 = pounds per 1000 gallons
mg/L x 0.225 = pounds per acre-inch

pounds per ton x 4.17 = pounds per 1000 gallons
pounds per ton x 113 = pounds per acre-inch

pounds per 1000 gallons x 0.24 = pounds per ton
pounds per 1000 gallons x 27.2 = pounds per acre-inch

pounds per acre-inch x 0.037 = pounds per 1000 gallons
pounds per acre-inch x 0.0089 = pounds per ton

1 gallon = 8.34 pounds
1 acre-inch = 27,200 gallons or 1815 cubic feet
1 mg/L = 1 ppm

1 acre = 43,560 square feet
1 cubic foot = 7.5 gallons
62.5 pounds = cubic foot (liquids)

Swine, Dairy, Beef, Horse, Sheep Manure = (solids) 60 lbs cubic foot or 33 cubic feet/ton
Swine, Dairy, Beef, Horse, Sheep Manure = (liquids) 62.5 lbs cubic foot or 32 cubic feet/ton
Poultry = 27 lbs cubic foot or 74 cubic feet/ton

Appendix B

Nutrient Content of Chicken Manure

Appendix B

Revised May 2008

Cal-Maine continues to decrease the number of birds housed. This year 94,000 birds will be placed in eight layer houses and 90,500 birds will be placed in five layer houses. The remaining 10 layer houses will continue to have 98,000 birds each. The pullets will be decreased to 97,500 chicks except for four flocks that will each have 110,000 chicks (the extra pullets will be for a separate operation). The total current estimated litter production is 29,515 tons from both layers and pullets.

An estimate of the nutrients available from the chicken manure produced at Cal-Maine's Guthrie facility is revised each year, based on the average nutrient content in the samples most recently collected. The table presents the average nutrient content in the pullet litter and in the layer litter for 2008.

Nutrients in Chicken Litter, 2008 (pounds per ton of litter)		
Nutrient	**Pullets Average Value**	**Layers Average Value**
Nitrogen (N)	**98**	**64.85**
Orthophosphate (P_2O_5)	**52**	**68.77**
Potassium (K_2O)	**49**	**56.62**

Based on a total annual manure production of 28,560 tons (25,190 tons from layers and 3,370 tons from pullets) and the laboratory-reported nutrient values in the analyzed samples, the estimated amounts of nutrients produced in chicken litter and available for land application in 2007 are:

Nutrients in Chicken Litter 2008 (total pounds)				Weighted Average (pounds per ton)
Nutrient	**Pullets**	**Layers**	**Total**	**Pullets + Layers**
Nitrogen (N)	444,136	1,620,148	2,064,284	72.28
Orthophosphate (P_2O_5)	235,664	1,718,081	1,953,745	68.41
Potassium (K_2O)	222,068	1,414,537	1,636,605	57.30

UNIT CONVERSION TABLE

unit for solid manure = Ton
unit for liquid manure = 1000 gal or acre inch

P (elemental phosphorus) x 2.29 = P205 (phosphorus)
K (elemental potassium) x 1.2 = K20 (potash)

percent (%) x 20 = pounds per ton
percent (%) x 80 = pounds per 1000 gallons
percent (%) x 2254 = pounds per acre-inch

mg/L x 0.002 = pounds per ton
mg/L x 0.008 = pounds per 1000 gallons
mg/L x 0.225 = pounds per acre-inch

pounds per ton x 4.17 = pounds per 1000 gallons
pounds per ton x 113 = pounds per acre-inch

pounds per 1000 gallons x 0.24 = pounds per ton
pounds per 1000 gallons x 27.2 = pounds per acre-inch

pounds per acre-inch x 0.037 = pounds per 1000 gallons
pounds per acre-inch x 0.0089 = pounds per ton

1 gallon = 8.34 pounds
1 acre-inch = 27,200 gallons or 1815 cubic feet
1 mg/L = 1 ppm

1 acre = 43,560 square feet
1 cubic foot = 7.5 gallons
62.5 pounds = cubic foot (liquids)

Swine, Dairy, Beef, Horse, Sheep Manure = (solids) 60 lbs cubic foot or 33 cubic feet/ton
Swine, Dairy, Beef, Horse, Sheep Manure = (liquids) 62.5 lbs cubic foot or 32 cubic feet/ton
Poultry = 27 lbs cubic foot or 74 cubic feet/ton

Appendix B

Nutrient Content of Chicken Manure

Appendix B

Revised May 2008

Cal-Maine continues to decrease the number of birds housed. This year 94,000 birds will be placed in eight layer houses and 90,500 birds will be placed in five layer houses. The remaining 10 layer houses will continue to have 98,000 birds each. The pullets will be decreased to 97,500 chicks except for four flocks that will each have 110,000 chicks (the extra pullets will be for a separate operation). The total current estimated litter production is 29,515 tons from both layers and pullets.

An estimate of the nutrients available from the chicken manure produced at Cal-Maine's Guthrie facility is revised each year, based on the average nutrient content in the samples most recently collected. The table presents the average nutrient content in the pullet litter and in the layer litter for 2008.

Nutrients in Chicken Litter, 2008 (pounds per ton of litter)		
Nutrient	**Pullets Average Value**	**Layers Average Value**
Nitrogen (N)	**98**	**64.85**
Orthophosphate (P_2O_5)	**52**	**68.77**
Potassium (K_2O)	**49**	**56.62**

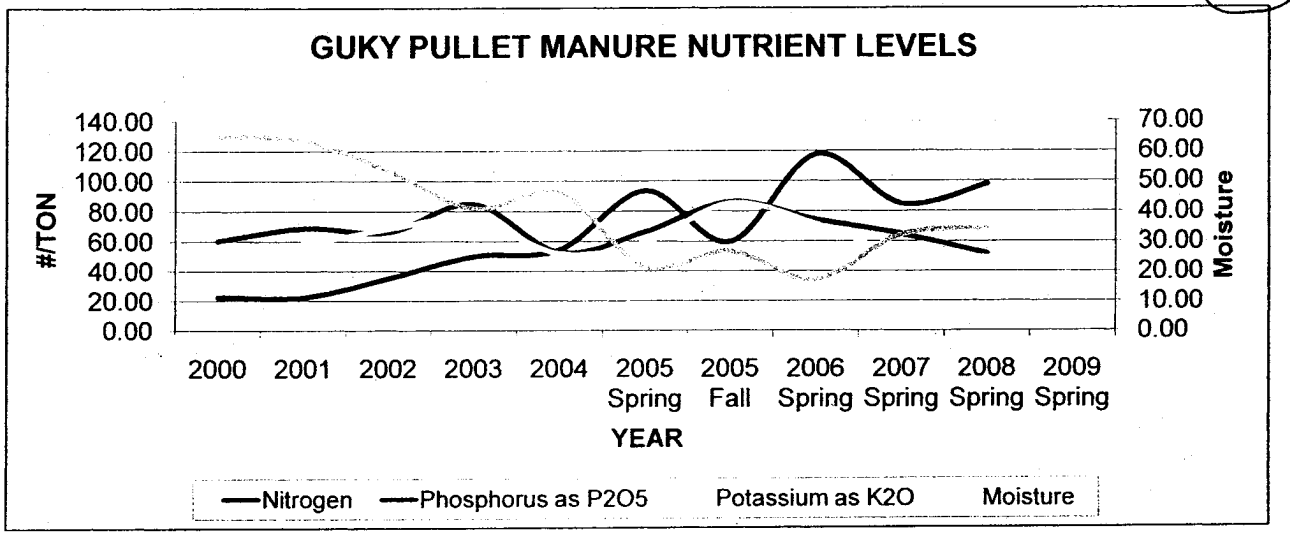
Based on a total annual manure production of 28,560 tons (25,190 tons from layers and 3,370 tons from pullets) and the laboratory-reported nutrient values in the analyzed samples, the estimated amounts of nutrients produced in chicken litter and available for land application in 2007 are:

Nutrients in Chicken Litter 2008 (total pounds)				Weighted Average (pounds per ton)
Nutrient	**Pullets**	**Layers**	**Total**	**Pullets + Layers**
Nitrogen (N)	444,136	1,620,148	2,064,284	72.28
Orthophosphate (P_2O_5)	235,664	1,718,081	1,953,745	68.41
Potassium (K_2O)	222,068	1,414,537	1,636,605	57.30

4/7/2008

GUTHRIE PULLET WASTE ANALYSIS

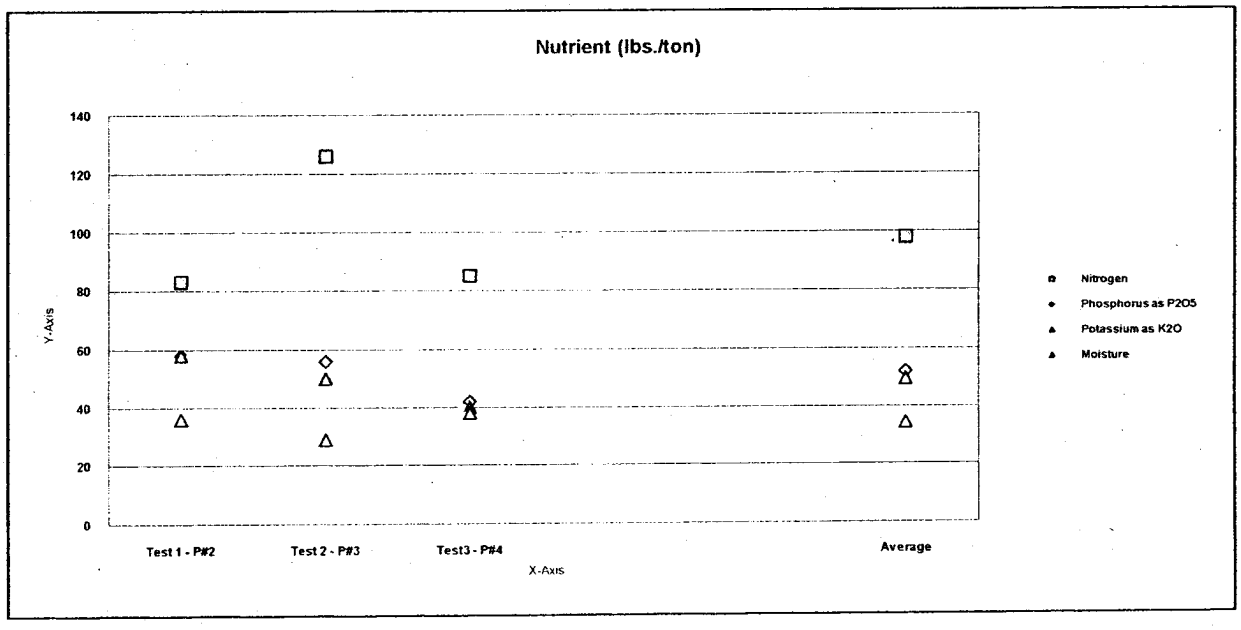
Nutrient (lbs./ton)	2000 AVERAGE	2001 AVERAGE	2002 AVERAGE	2003 AVERAGE	2004 AVERAGE	2005 Spring AVERAGE	2005 Fall AVERAGE	2006 Spring AVERAGE	2007 Spring AVERAGE	2008 Spring AVERAGE
Nitrogen	22.71	22.50	35.33	50.00	54.67	93.67	60.00	117.67	85.00	98.00
Phosphorus as P2O5	60.61	69.00	66.67	85.00	53.00	66.67	86.40	74.67	65.00	52.00
Potassium as K2O	56.47	58.50	69.00	75.00	52.00	59.33	85.60	71.67	51.00	49.33
Moisture	65.16	63.50	53.67	41.00	46.33	21.67	26.80	17.33	32.33	34.33



2008 (Spring) GUTHRIE PULLET WASTE ANALYSIS 4/11/2008

Sample Date
3/22/2008

Nutrient (lbs./ton)	Test 1 - P#2	Test 2 - P#3	Test3 - P#4	Average
Nitrogen	83	126	85	98.00
Phosphorus as P2O5	58	56	42	52.00
Potassium as K2O	58	50	40	49.33
Moisture	36	29	38	34.33



Manure Test Report

University of Kentucky
Division of Regulatory Services

TODD County Extension Office

Owner

Cal-Maine Foods, Inc.
P.O. Box 40
Guthrie KY 42234
270-483-2002

Manure Type: Poultry Solid

Sample Identification

UK Lab No	County Code
90070	219
County ID	**Owner ID**
3037	P2
Received	**Reported**
3/24/2008	4/2/2008

Nutrient Results *(in lbs/ton as received)*

N	83	Zn	0.55
P2O5	58	Cu	0.04
K2O	58	Mn	0.39
Ca	40		
Mg	9		

% Moisture

36

Extension Agent

Information on land applying manure can be found in UK Extension publications ID-123, AGR-146 and 146A (poultry litter), and ASC-80 (swine manure).

Manure Test Report

University of Kentucky
Division of Regulatory Services

TODD County Extension Office

Owner

Cal-Maine Foods, Inc.
P.O. Box 40
Guthrie KY 42234
270-483-2002

Sample Identification

UK Lab No	County Code
90071	219
County ID	**Owner ID**
3038	P3
Received	**Reported**
3/24/2008	4/2/2008

Manure Type: Poultry Solid

Nutrient Results *(in lbs/ton as received)*

N	126	Zn	0.44
P2O5	56	Cu	0.06
K2O	50	Mn	0.37
Ca	39		
Mg	8		

% Moisture

29

Extension Agent

Information on land applying manure can be found in UK Extension publications ID-123, AGR-146 and 146A (poultry litter), and ASC-80 (swine manure).

Manure Test Report

University of Kentucky
Division of Regulatory Services

TODD County Extension Office

Owner

Cal-Maine Foods, Inc.
P.O. Box 40
Guthrie KY 42234
270-483-2002

Sample Identification

UK Lab No	County Code
90072	219
County ID	Owner ID
3039	P4
Received	Reported
3/24/2008	4/2/2008

Manure Type: Poultry Solid

Nutrient Results *(in lbs/ton as received)*

N	85	Zn	0.5
P2O5	42	Cu	0.04
K2O	40	Mn	0.23
Ca	31		
Mg	7		

% Moisture

38

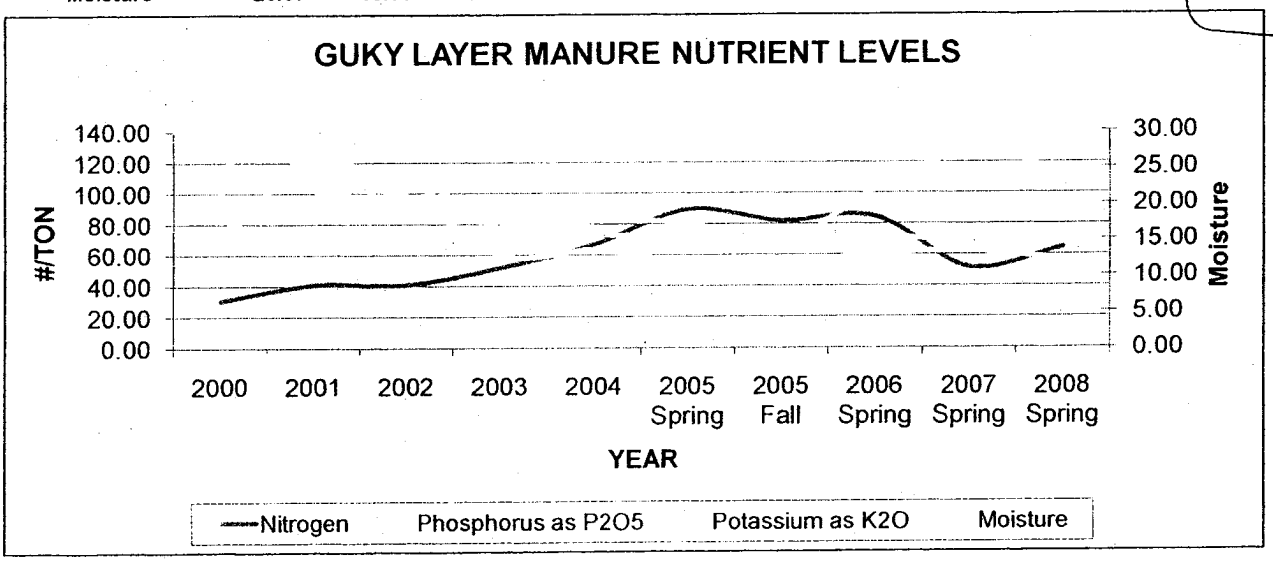
Extension Agent

Information on land applying manure can be found in UK Extension publications ID-123, AGR-146 and 146A (poultry litter), and ASC-80 (swine manure).

4/11/2008

GUTHRIE LAYER WASTE ANALYSIS

Nutrient (lbs./ton)	2000 AVERAGE	2001 AVERAGE	2002 AVERAGE	2003 AVERAGE	2004 AVERAGE	2005 Spring AVERAGE	2005 Fall AVERAGE	2006 Spring AVERAGE	2007 Spring AVERAGE	2008 Spring AVERAGE
Nitrogen	30.67	41.00	41.00	51.83	67.17	89.57	82.13	84.89	51.80	64.85
Phosphorus as P2O5	101.00	121.00	107.00	78.00	73.33	70.71	75.50	72.33	67.87	68.77
Potassium as K2O	76.67	98.33	98.67	60.00	62.83	55.00	53.78	60.44	62.07	56.62
Moisture	26.67	18.00	23.33	17.50	17.50	17.29	14.38	22.00	27.20	24.46

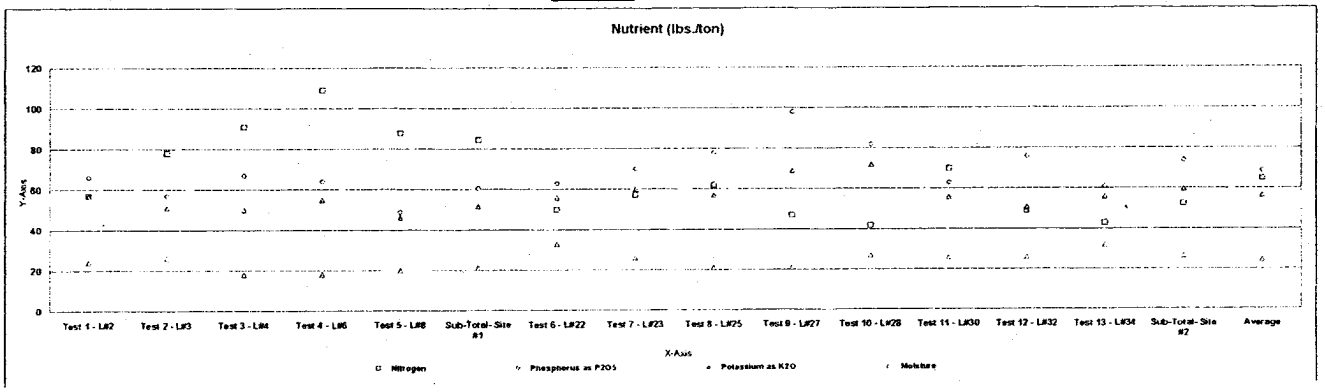


2008 Layer (Spring)

Guthrie Layer Waste Analysis

4/11/2008

										Sample Date 3/22/2008						
Nutrient (lbs./ton)	Test 1 - L#2	Test 2 - L#3	Test 3 - L#4	Test 4 - L#6	Test 5 - L#8	Sub-Total- Site #1	Test 6 - L#22	Test 7 - L#23	Test 8 - L#25	Test 9 - L#27	Test 10 - L#28	Test 11 - L#30	Test 12 - L#32	Test 13 - L#34	Sub-Total- Site #2	Average
Nitrogen	57	78	91	109	88	84.60	50	57	62	47	42	70	49	43	52.50	64.85
Phosphorus as P2O5	66	57	67	64	49	60.60	63	70	78	98	82	63	76	61	73.88	68.77
Potassium as K2O	57	51	50	55	46	51.80	56	60	57	69	72	56	51	56	59.63	56.62
Moisture	24	26	18	18	20	21.20	33	26	21	21	27	26	26	32	26.50	24.46



GUTHRIE LAYER WASTE ANALYSIS

Manure Test Report

University of Kentucky
Division of Regulatory Services

TODD County Extension Office

Owner

Cal-Maine Foods, Inc.
P.O. Box 40
Guthrie KY 42234
270-483-2002

Sample Identification

UK Lab No	County Code
90073	219
County ID	**Owner ID**
3040	L2
Received	**Reported**
3/24/2008	4/2/2008

Manure Type: Poultry Solid

Nutrient Results *(in lbs/ton as received)*

N	57	Zn	1.13
P2O5	66	Cu	0.22
K2O	57	Mn	1.01
Ca	182		
Mg	10		

% Moisture

24

Extension Agent

Information on land applying manure can be found in UK Extension publications ID-123, AGR-146 and 146A (poultry litter), and ASC-80 (swine manure).

Manure Test Report

University of Kentucky
Division of Regulatory Services

TODD County Extension Office

Owner

Cal-Maine Foods, Inc.
P.O. Box 40
Guthrie KY 42234
270-483-2002

Sample Identification

UK Lab No	County Code
90074	219
County ID	Owner ID
3041	L3
Received	Reported
3/24/2008	4/2/2008

Manure Type: Poultry Solid

Nutrient Results *(in lbs/ton as received)*

N	78	Zn	0.96
P2O5	57	Cu	0.19
K2O	51	Mn	0.86
Ca	141		
Mg	9		

% Moisture

26

Extension Agent

Information on land applying manure can be found in UK Extension publications ID-123, AGR-146 and 146A (poultry litter), and ASC-80 (swine manure).

Manure Test Report

University of Kentucky
Division of Regulatory Services

TODD County Extension Office

Owner

Cal-Maine Foods, Inc.
P.O. Box 40
Guthrie KY 42234
270-483-2002

Sample Identification

UK Lab No	County Code
90075	219
County ID	Owner ID
3042	L4
Received	Reported
3/24/2008	4/2/2008

Manure Type: Poultry Solid

Nutrient Results *(in lbs/ton as received)*

N	91	Zn	1.11
P2O5	67	Cu	0.21
K2O	50	Mn	0.92
Ca	164		
Mg	10		

% Moisture

18

Extension Agent

Information on land applying manure can be found in UK Extension publications ID-123, AGR-146 and 146A (poultry litter), and ASC-80 (swine manure).

Manure Test Report

University of Kentucky
Division of Regulatory Services

TODD County Extension Office

Owner

Cal-Maine Foods, Inc.
P.O. Box 40
Guthrie KY 42234
270-483-2002

Sample Identification

UK Lab No	County Code
90076	219
County ID	Owner ID
3043	L6
Received	Reported
3/24/2008	4/2/2008

Manure Type: Poultry Solid

Nutrient Results *(in lbs/ton as received)*

N	109	Zn	1.05
P2O5	64	Cu	0.21
K2O	55	Mn	0.86
Ca	151		
Mg	10		

% Moisture

18

Extension Agent

Information on land applying manure can be found in UK Extension publications ID-123, AGR-146 and 146A (poultry litter), and ASC-80 (swine manure).

Manure Test Report

University of Kentucky
Division of Regulatory Services

TODD County Extension Office

Owner

Cal-Maine Foods, Inc.
P.O. Box 40
Guthrie KY 42234
270-483-2002

Sample Identification

UK Lab No	County Code
90077	219
County ID	Owner ID
3044	L8
Received	Reported
3/24/2008	4/2/2008

Manure Type: Poultry Solid

Nutrient Results *(in lbs/ton as received)*

N	88	Zn	0.85
P2O5	49	Cu	0.16
K2O	46	Mn	0.73
Ca	153		
Mg	9		

% Moisture

20

Extension Agent

Information on land applying manure can be found in UK Extension publications ID-123, AGR-146 and 146A (poultry litter), and ASC-80 (swine manure).

Manure Test Report

University of Kentucky
Division of Regulatory Services

TODD County Extension Office

Owner

Cal-Maine Foods, Inc.
P.O. Box 40
Guthrie KY 42234
270-483-2002

Sample Identification

UK Lab No	County Code
90078	219
County ID	Owner ID
3045	L22
Received	Reported
3/24/2008	4/2/2008

Manure Type: Poultry Solid

Nutrient Results *(in lbs/ton as received)*

N	50	Zn	0.58
P2O5	63	Cu	0.05
K2O	56	Mn	0.43
Ca	180		
Mg	11		

% Moisture

33

Extension Agent

Information on land applying manure can be found in UK Extension publications ID-123, AGR-146 and 146A (poultry litter), and ASC-80 (swine manure).

Manure Test Report

University of Kentucky
Division of Regulatory Services

TODD County Extension Office

Owner

Cal-Maine Foods, Inc.
P.O. Box 40
Guthrie KY 42234
270-483-2002

Sample Identification

UK Lab No	County Code
90079	219
County ID	Owner ID
3046	L23
Received	Reported
3/24/2008	4/2/2008

Manure Type: Poultry Solid

Nutrient Results *(in lbs/ton as received)*

N	57	Zn	0.92
P2O5	70	Cu	0.13
K2O	60	Mn	0.75
Ca	177		
Mg	10		

% Moisture

26

Extension Agent

Information on land applying manure can be found in UK Extension publications ID-123, AGR-146 and 146A (poultry litter), and ASC-80 (swine manure).

Manure Test Report

University of Kentucky
Division of Regulatory Services

TODD County Extension Office

Owner

Cal-Maine Foods, Inc.
P.O. Box 40
Guthrie KY 42234
270-483-2002

Sample Identification

UK Lab No	County Code
90080	219
County ID	Owner ID
3047	L25
Received	Reported
3/24/2008	4/2/2008

Manure Type: Poultry Solid

Nutrient Results *(in lbs/ton as received)*

N	62	Zn	0.65
P2O5	78	Cu	0.07
K2O	57	Mn	0.48
Ca	221		
Mg	11		

% Moisture

21

Extension Agent

Information on land applying manure can be found in UK Extension publications ID-123, AGR-146 and 146A (poultry litter), and ASC-80 (swine manure).

Manure Test Report

University of Kentucky
Division of Regulatory Services

TODD County Extension Office

Owner

Cal-Maine Foods, Inc.
P.O. Box 40
Guthrie KY 42234
270-483-2002

Sample Identification

UK Lab No	County Code
90081	219
County ID	**Owner ID**
3048	L27
Received	**Reported**
3/24/2008	4/2/2008

Manure Type: Poultry Solid

Nutrient Results *(in lbs/ton as received)*

N	47	Zn	0.73
P2O5	98	Cu	0.15
K2O	69	Mn	0.55
Ca	260		
Mg	14		

% Moisture

21

Extension Agent

Information on land applying manure can be found in UK Extension publications ID-123, AGR-146 and 146A (poultry litter), and ASC-80 (swine manure).

Manure Test Report

University of Kentucky
Division of Regulatory Services

TODD County Extension Office

Owner

Cal-Maine Foods, Inc.
P.O. Box 40
Guthrie KY 42234
270-483-2002

Sample Identification

UK Lab No	County Code
90082	219
County ID	**Owner ID**
3049	L28
Received	**Reported**
3/24/2008	4/2/2008

Manure Type: Poultry Solid

Nutrient Results *(in lbs/ton as received)*

N	42	Zn	0.76
P2O5	82	Cu	0.07
K2O	72	Mn	0.55
Ca	227		
Mg	14		

% Moisture

27

Extension Agent

Information on land applying manure can be found in UK Extension publications ID-123, AGR-146 and 146A (poultry litter), and ASC-80 (swine manure).

Manure Test Report

University of Kentucky
Division of Regulatory Services

TODD County Extension Office

Owner

Cal-Maine Foods, Inc.
P.O. Box 40
Guthrie KY 42234
270-483-2002

Sample Identification

UK Lab No	County Code
90084	219
County ID	Owner ID
3050	L30
Received	Reported
3/24/2008	4/10/2008

Manure Type: Poultry Solid

Nutrient Results *(in lbs/ton as received)*

N	70	Zn	1.03
P2O5	63	Cu	0.16
K2O	56	Mn	0.71
Ca	175		
Mg	11		

% Moisture

26

Extension Agent

Information on land applying manure can be found in UK Extension publications ID-123, AGR-146 and 146A (poultry litter), and ASC-80 (swine manure).

Manure Test Report

University of Kentucky
Division of Regulatory Services

TODD County Extension Office

Owner

Cal-Maine Foods, Inc.
P.O. Box 40
Guthrie KY 42234
270-483-2002

Sample Identification

UK Lab No	County Code
90085	219
County ID	Owner ID
3051	L32
Received	Reported
3/24/2008	4/10/2008

Manure Type: Poultry Solid

Nutrient Results *(in lbs/ton as received)*

N	49	Zn	0.57
P2O5	76	Cu	0.06
K2O	51	Mn	0.41
Ca	220		
Mg	11		

% Moisture

26

Extension Agent

Information on land applying manure can be found in UK Extension publications ID-123, AGR-146 and 146A (poultry litter), and ASC-80 (swine manure).

Manure Test Report

University of Kentucky
Division of Regulatory Services

TODD County Extension Office

Owner

Cal-Maine Foods, Inc.
P.O. Box 40
Guthrie KY 42234
270-483-2002

Sample Identification

UK Lab No	County Code
90086	219
County ID	**Owner ID**
3052	L34
Received	**Reported**
3/24/2008	4/10/2008

Manure Type: Poultry Solid

Nutrient Results *(in lbs/ton as received)*

N	43	Zn	0.83
P2O5	61	Cu	0.16
K2O	56	Mn	0.65
Ca	179		
Mg	10		

% Moisture

32

Extension Agent

Information on land applying manure can be found in UK Extension publications ID-123, AGR-146 and 146A (poultry litter), and ASC-80 (swine manure).

Appendix C

Nutrient Content of Wastewater Effluent

Appendix C
Nutrient Content of Wastewater Effluent

Revised May 2008

The following table summarizes the lab data for the lagoon and wastewater treatment plant analyses for samples collected in March 2008 and samples collected in 2007. The laboratory reports are in this Appendix.

Nutrients in Wastewater Effluent, March 2008
(milligrams per liter [mg/L])

Nutrient	Average
Lagoon	
Nitrate as N	**0.678**
Ammonia nitrogen as N	**5.683**
Total phosphorus as P	**21.5**
Wastewater Treatment Plan	
Nitrate as N	**117**
Ammonia nitrogen as N	**0.796**
Total phosphorus as P	**17.9**

LAGOON WASTEWATER NUTRIENTS
Based on the average nutrient content in the lagoon effluent sample:

Plant-Available Nitrogen:

6.36 mg/L x 50% = 3.18
0.000027 pounds N per gallon of wastewater

Phosphorus:

21.50 mg/L x 0.90 =
0.000161 pounds of phosphorus/gallon, or
0.000370 pounds of orthophosphate/gallon

WASTEWATER TREATMENT PLANT NUTRIENTS
Based on the average nutrient content in the WWTP holding tank sample:

Plant-Available Nitrogen:

117.80 mg/L x 50% = 58.90
0.000491 pounds N per gallon of wastewater

Phosphorus:

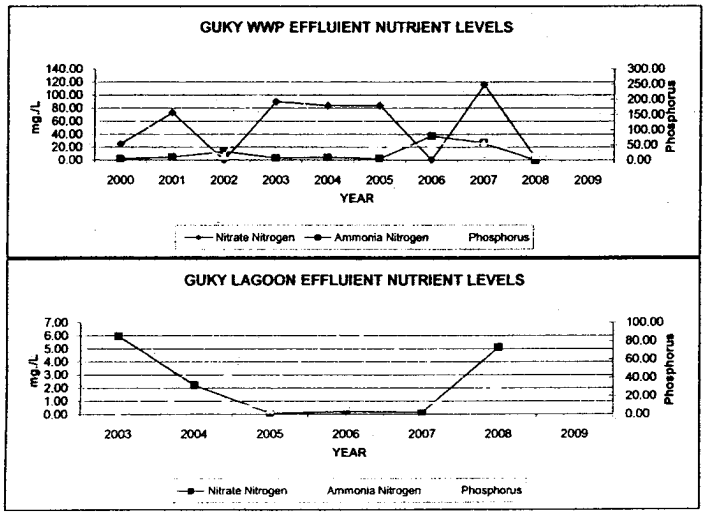
17.90 mg/L x 0.90 =
0.000134 pounds of phosphorus/gallon, or
0.000308 pounds of orthophosphate/gallon

4/7/2008

GUTHRIE LAGOON and WWP Effluient ANALYSIS

WWP:		2000 AVERAGE	2001 AVERAGE	2002 AVERAGE	2003 AVERAGE	2004 AVERAGE	2005 AVERAGE	2006 AVERAGE	2007 AVERAGE	2008 AVERAGE	2009 AVERAGE
Nitrate Nitrogen	mg/L	25.00	73.20	?	90.00	83.95	84.00	0.38	116.00	2.90	
Ammonia Nitrogen	mg/L	2.37	5.17	13.50	3.55	4.67	2.66	37.70	27.10	0.00	
Phosphorus	mg/L	160.00	67.50	15.80	321.05	73.40	38.90	54.70	58.00	18.70	

LAGOON		2003 AVERAGE	2004 AVERAGE	2005 AVERAGE	2006 AVERAGE	2007 AVERAGE	2008 AVERAGE	2009 AVERAGE
Nitrate Nitrogen	mg/L	6.00	2.25	0.12	0.24	0.18	5.16	
Ammonia Nitrogen	mg/L	0.16	20.27	5.59	9.06	9.96	29.93	
Phosphorus	mg/L	0.75	48.95	34.93	92.07	60.70	21.30	



TestAmerica
THE LEADER IN ENVIRONMENTAL TESTING
2960 Foster Creighton Road Nashville, TN 37204 * 800-765-0980 * Fax 615-726-3404

Annual Test

Client	Cal-Maine Foods, Inc. (11368)	Work Order:	NRC1432
	P. O. Box 40	Project Name:	Wastewater
	Guthrie, KY 42234	Project Number:	[none]
Attn	Marc Ashby	Received:	03/18/08 09:40

ANALYTICAL REPORT

Analyte	Result	Flag	Units	MRL	Dilution Factor	Analysis Date/Time	Method	Batch
Sample ID: NRC1432-01 (Lagoon - Waste Water) Sampled: 03/17/08 08:15								
General Chemistry Parameters								
Ammonia as N	**2.90**		mg/L	0.100	1	03/27/08 13:51	EPA 350.1M	8034042
Nitrate/Nitrite as N	ND		mg/L	0.100	1	03/25/08 19:44	SM4500-NO3 F	8033910
Phosphorus	**18.7**		mg/L	1.00	10	03/27/08 11:13	EPA 365.4	8034051
Sample ID: NRC1432-02 (#1 Holding Tank - Waste Water) Sampled: 03/17/08 08:20								
General Chemistry Parameters								
Ammonia as N	**0.796**		mg/L	0.100	1	03/27/08 13:51	EPA 350.1M	8034042
Nitrate/Nitrite as N	**117**		mg/L	1.00	10	03/25/08 20:35	SM4500-NO3 F	8033910
Phosphorus	**17.9**		mg/L	1.00	10	03/27/08 11:13	EPA 365.4	8034051

TestAmerica
THE LEADER IN ENVIRONMENTAL TESTING
2960 Foster Creighton Road Nashville, TN 37204 * 800-765-0980 * Fax 615-726-3404

t Cal-Maine Foods, Inc. (11368)
P. O. Box 40
Guthrie, KY 42234
Attn Marc Ashby

Work Order: NQL1908
Project Name: Wastewater
Project Number: [none]
Received: 12/18/07 10:15

ANALYTICAL REPORT

Analyte	Result	Flag	Units	MRL	Dilution Factor	Analysis Date/Time	Method	Batch
Sample ID: NQL1908-01 (Lagoon - Waste Water) Sampled: 12/17/07 08:25								
General Chemistry Parameters								
Ammonia as N	**2.42**		mg/L	0.100	1	12/31/07 12:02	EPA 350.1M	7124777
Nitrate/Nitrite as N	**0.692**		mg/L	0.100	1	12/27/07 23:06	SM4500-NO3 F	7124330
Phosphorus	**13.3**		mg/L	1.00	10	01/04/08 12:04	EPA 365.4	8010225

TestAmerica
THE LEADER IN ENVIRONMENTAL TESTING
2960 Foster Creighton Road Nashville, TN 37204 * 800-765-0980 * Fax 615-726-3404

Client: Cal-Maine Foods, Inc. (11368)
P. O. Box 40
Guthrie, KY 42234
Attn: Marc Ashby

Work Order: NQI2343
Project Name: Wastewater
Project Number: [none]
Received: 09/20/07 10:00

ANALYTICAL REPORT

Analyte	Result	Flag	Units	MRL	Dilution Factor	Analysis Date/Time	Method	Batch
Sample ID: NQI2343-01 (Lagoon - Waste Water) Sampled: 09/19/07 07:15								
General Chemistry Parameters								
Ammonia as N	**8.31**		mg/L	0.100	1	09/28/07 15:02	EPA 350.1M	7094727
Nitrate/Nitrite as N	ND		mg/L	0.100	1	09/25/07 19:40	SM4500-NO3 F	7094659
Phosphorus	**17.8**		mg/L	0.500	5	10/01/07 08:34	EPA 365.4	7095310

TestAmerica
ANALYTICAL TESTING CORPORATION
2960 Foster Creighton Road Nashville, TN 37204 * 800-765-0980 * Fax 615-726-3404

Client	Cal-Maine Foods, Inc. (11368)	Work Order:	NQF2512
	P. O. Box 40	Project Name:	Wastewater
	Guthrie, KY 42234	Project Number:	[none]
Attn	Marc Ashby	Received:	06/20/07 09:40

ANALYTICAL REPORT

Analyte	Result	Flag	Units	MRL	Dilution Factor	Analysis Date/Time	Method	Batch
Sample ID: NQF2512-01 (Lagoon - Waste Water) Sampled: 06/19/07 07:45								
General Chemistry Parameters								
Ammonia as N	**9.10**		mg/L	0.100	1	06/29/07 13:47	EPA 350.1M	7065380
Nitrate/Nitrite as N	**2.02**		mg/L	2.00	20	06/20/07 18:16	SM4500-NO3 F	7063687
Phosphorus	**36.2**		mg/L	2.00	20	06/29/07 17:01	EPA 365.4	7065378

Appendix D

Soil Test Laboratory Reports

Appendix D
Soil Test Laboratory Reports
Revised May 2008

The soil test data are reviewed annually for determination of nutrients needed for crops and, in particular, for residual phosphorus levels in the soil. Review of the soil test data for 2008 indicates the following phosphorus levels:

North Field:	227 pounds/acre
South Field:	261 pounds/acre
Sprayfield #1 (south field):	468 pounds/acre
Sprayfield #2 (north field):	347 pounds/acre

The phosphorus in the soil of Sprayfield #1 was 892 pounds per acre in 2004 when spray application was discontinued. The phosphorus levels in that field decreased in 2005 and again in 2006, when soil testing indicated that the phosphorus level was 156 pounds/acre. Spray application of wastewater was then resumed. In 2007 the residual phosphorus was 387 pounds per acre, higher than in 2006, but still within the range acceptable for nitrogen-based land application. The 2008 residual phosphorus level in the south sprayfield has risen again, to 468 pounds per acre. The 2008 residual phosphorus levels in the other fields are all higher than in 2007, but below 400 pounds per acre.

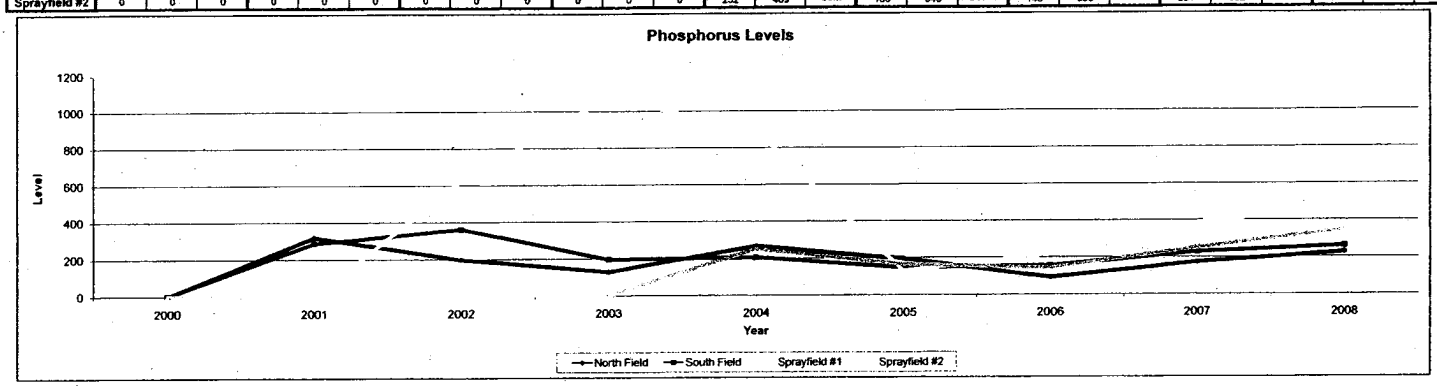
Based on the Kentucky Phosphorus Index factors (see Appendix E), the calculated phosphorus index indicates a medium potential for phosphorus movement from all fields. Although phosphorus levels exceed 400 pounds per acre in Sprayfield #1, Cal-Maine can still land-apply using nitrogen-based application rates. The soil test data for 2008 indicate that land application on all fields is acceptable.

If soil tests indicate that phosphorus exceeds 1,066 pounds per acre, no future applications of phosphorus from any nutrient source can be made. Soil test data will be reviewed annually, and land-application patterns will be modified to control and mitigate residual phosphorus concentrations in the soil.

4/7/2008

GUTHRIE SOIL SAMPLE ANALYSIS

	2000			2001			2002			2003			2004			2005			2006			2007			2008		
CATION	P	K	Crop	P	K	Crop	P	K	Crop	P	K	Crop	P	K	Crop	P	K	Crop	P	K	Crop	P	K	Crop	P	K	Crop
North Field	>200	520	Corn	319	465	Wheat/ Beans	198	499	Corn	129	339	Wheat/ Beans	267	461	Corn	195	502	Wheat/ Beans	92	367	Corn	173	375	Wheat/ Beans	227	392	Wheat/ Beans
South Field	>200	499	Wheat/ Beans	287	534	Corn	363	690	Wheat/ Beans	197	419	Corn	206	383	Wheat/ Beans	149	399	Corn	156	353	Wheat/ Beans	230	292	Corn	261	372	Wheat/ Beans
Sprayfield #1	0	0	0	0	0	0	623	125	Wheat/ Beans	1076	1425	Corn	892	1211	Wheat/ Beans	131	338	Corn	218	476	Wheat/ Beans	387	457	Corn	468	493	Wheat/ Beans
Sprayfield #2	0	0	0	0	0	0	0	0	0	0	0	0	252	489	Corn	165	343	Wheat/ Beans	146	350	Corn	251	352	Wheat/ Beans	347	448	Wheat/ Beans



From:
Todd County Extension Service
PO Box 97
F" ton, KY 42220-0097

UK COOPERATIVE EXTENSION SERVICE
University of Kentucky – College of Agriculture

Soil Test Report

Lexington 859-257-2785
Princeton 270-365-7541
www.rs.uky.edu/soils

COUNTY SAMPLE NO.: 0082

REPORT FORM: A

To:
CAL MAINE,
PO BOX 40
GUTHRIE, KY 42234

Curt Judy (270) 265-5659
CEA for ANR

Date	Owner Sample ID	Owner ID	County Code	UK Lab NO.
3/26/2008	NORTH	49	219	65353

Nutrient	Lab Results	Level of Adequacy (Very Low / Low / Medium / High / Very High)	Calculated CEC Data	
Phosphorus (P)	227	>>>		
Potassium (K)	392	>>	CEC (meg/100g):	14
Soil pH	6.8		%Base Sat.:	69
Buffer pH	7.0		%K:	3
Calcium (Ca)	3912		%Ca:	61
Magnesium (Mg)	186	>>	%Mg:	5
Zinc (Zn)	11.5		%H:	31
Other Test				

Acres	Primary Crop	Primary Management	Primary Use	Previous Crop	Previous Management	Previous Use	Crop 2 Years Ago Tobacco	Soil Drainage
	Wheat/Soybeans	No Tillage	Grain	Corn	No Tillage			

RECOMMENDATIONS:	N	P2O5	K2O	LIME	Mg	Zn
	see comments below	None	None	None	None	None

"ND BILL

COMMENTS:

Mehlich III used for P, K, Ca, Mg, and Zn (lbs/acre). Crop response is highly probable with Very Low or Low soil levels, slight with Medium, and not likely with High or Very High. N, P2O5, K2O, Mg, and Zn recommendations are based on lbs of the nutrient. Fertilizer needed will depend on nutrient content in the fertilizer. Soil pH and Sikora buffer pH are used for determining lime needs based on 100% effective lime. Lime quality in KY is defined by relative neutralizing value (RNV). RNV values for ag lime are determined by the KY Dept of Ag and are on the internet (publications at soils.rs.uky.edu).

FOR THE SMALL GRAIN CROP: FALL NITROGEN APPLICATION is not needed in fields following tobacco, soybeans, or well-fertilized corn or if litte growth of small grains is expected. For situations where little N carryover is expected, up to 40 lbs/acre of nitrogen is adequate for getting the small grain crop started. SPRING NITROGEN APPLICATION should be 60 to 90 lbs N/acre for a tilled seedbed or 90 to 120 lbs N/acre for a no-till seedbed. Application should occur between late February to early April. Where excessive rainfall occurs in late winter or early spring, split applications of nitrogen may be justified

FOR THE SOYBEAN CROP: No nitrogen is recommended in SPRING for soybeans.

Any P2O5 or K2O that is recommended can be applied in the fall before seeding the small grains as long as nitrogen application does not exceed 40 lb/ac. Small grains need very little nitrogen for fall growth.

From:
Todd County Extension Service
PO Box 97
F'' on, KY 42220-0097

UK COOPERATIVE EXTENSION SERVICE
University of Kentucky – College of Agriculture

Soil Test Report
Lexington 859-257-2785
Princeton 270-365-7541
www.rs.uky.edu/soils

COUNTY SAMPLE NO.: 0081

REPORT FORM: A

To:
CAL MAINE,
PO BOX 40
GUTHRIE, KY 42234

Curt Judy
CEA for ANR
(270)-265-5659

Date	Owner Sample ID	Owner ID	County Code	UK Lab NO.
3/26/2008	SOUTH	49	219	65352

Nutrient	Lab Results	Level of Adequacy: Very Low / Low / Medium / High / Very High
Phosphorus (P)	261	>>>
Potassium (K)	372	>>>
Soil pH	6.8	
Buffer pH	7.1	
Calcium (Ca)	4246	
Magnesium (Mg)	190	>>>
Zinc (Zn)	10.4	
Other Test		

Calculated CEC Data

CEC (meg/100g):	14
%Base Sat.:	74
%K:	3
%Ca:	66
%Mg:	5
%H:	26

Acres	Primary Crop	Primary Management	Primary Use	Previous Crop	Previous Management	Previous Use	Crop 2 Years Ago Tobacco	Soil Drainage
	Wheat/Soybeans	No Tillage	Grain	Corn	No Tillage			

RECOMMENDATIONS:	N	P2O5	K2O	LIME	Mg	Zn
	see comments below	None	None	None	None	None

'ND BILL

COMMENTS:

Mehlich III used for P, K, Ca, Mg, and Zn (lbs/acre). Crop response is highly probable with Very Low or Low soil levels, slight with Medium, and not likely with High or Very High. N, P2O5, K2O, Mg, and Zn recommendations are based on lbs of the nutrient. Fertilizer needed will depend on nutrient content in the fertilizer. Soil pH and Sikora buffer pH are used for determining lime needs based on 100% effective lime. Lime quality in KY is defined by relative neutralizing value (RNV). RNV values for ag lime are determined by the KY Dept of Ag and are on the internet (publications at soils.rs.uky.edu).

FOR THE SMALL GRAIN CROP: FALL NITROGEN APPLICATION is not needed in fields following tobacco, soybeans, or well-fertilized corn or if litte growth of small grains is expected. For situations where little N carryover is expected, up to 40 lbs/acre of nitrogen is adequate for getting the small grain crop started. SPRING NITROGEN APPLICATION should be 60 to 90 lbs N/acre for a tilled seedbed or 90 to 120 lbs N/acre for a no-till seedbed. Application should occur between late February to early April. Where excessive rainfall occurs in late winter or early spring, split applications of nitrogen may be justified

FOR THE SOYBEAN CROP: No nitrogen is recommended in SPRING for soybeans.

Any P2O5 or K2O that is recommended can be applied in the fall before seeding the small grains as long as nitrogen application does not exceed 40 lb/ac. Small grains need very little nitrogen for fall growth.

From:
Todd County Extension Service
PO Box 97
r" "ton, KY 42220-0097

UK COOPERATIVE EXTENSION SERVICE
University of Kentucky – College of Agriculture

Soil Test Report

Lexington 859-257-2785
Princeton 270-365-7541
www.rs.uky.edu/soils

COUNTY SAMPLE NO.: 0083

REPORT FORM: A

To:
CAL MAINE,
PO BOX 40
GUTHRIE, KY 42234

Curt Judy
Curt Judy (270)-265-5659
CEA for ANR

Date	Owner Sample ID	Owner ID	County Code	UK Lab NO.
3/26/2008	SPRAY 1	49	219	65354

Nutrient	Lab Results	Level of Adequacy (Very Low | Low | Medium | High | Very High)	Calculated CEC Data	
Phosphorus (P)	468	>>		
Potassium (K)	493	>>	CEC (meg/100g):	14
Soil pH	6.5		%Base Sat.:	65
Buffer pH	6.9		%K:	4
Calcium (Ca)	3624		%Ca:	56
Magnesium (Mg)	182	>>	%Mg:	5
Zinc (Zn)	15.0		%H:	35
Other Test				

Acres	Primary Crop	Primary Management	Primary Use	Previous Crop	Previous Management	Previous Use	Crop 2 Years Ago Tobacco	Soil Drainage
	Wheat/Soybeans	No Tillage	Grain	Corn	No Tillage			

RECOMMENDATIONS:	N	P2O5	K2O	LIME	Mg	Zn
	see comments below	None	None	None	None	None

¯ND BILL

COMMENTS:

Mehlich III used for P, K, Ca, Mg, and Zn (lbs/acre). Crop response is highly probable with Very Low or Low soil levels, slight with Medium, and not likely with High or Very High. N, P2O5, K2O, Mg, and Zn recommendations are based on lbs of the nutrient. Fertilizer needed will depend on nutrient content in the fertilizer. Soil pH and Sikora buffer pH are used for determining lime needs based on 100% effective lime. Lime quality in KY is defined by relative neutralizing value (RNV). RNV values for ag lime are determined by the KY Dept of Ag and are on the internet (publications at soils.rs.uky.edu).

FOR THE SMALL GRAIN CROP: FALL NITROGEN APPLICATION is not needed in fields following tobacco, soybeans, or well-fertilized corn or if litte growth of small grains is expected. For situations where little N carryover is expected, up to 40 lbs/acre of nitrogen is adequate for getting the small grain crop started. SPRING NITROGEN APPLICATION should be 60 to 90 lbs N/acre for a tilled seedbed or 90 to 120 lbs N/acre for a no-till seedbed. Application should occur between late February to early April. Where excessive rainfall occurs in late winter or early spring, split applications of nitrogen may be justified

FOR THE SOYBEAN CROP: No nitrogen is recommended in SPRING for soybeans.

Any P2O5 or K2O that is recommended can be applied in the fall before seeding the small grains as long as nitrogen application does not exceed 40 lb/ac. Small grains need very little nitrogen for fall growth.

From: Todd County Extension Service PO Box 97 E''ton, KY 42220-0097	UK COOPERATIVE EXTENSION SERVICE University of Kentucky – College of Agriculture	Soil Test Report Lexington 859-257-2785 Princeton 270-365-7541 www.rs.uky.edu/soils
COUNTY SAMPLE NO.: 0084 REPORT FORM: A	To: CAL MAINE, PO BOX 40 GUTHRIE, KY 42234	Curt Judy (signature) Curt Judy (270)-265-5659 *CEA for ANR*

Date	Owner Sample ID	Owner ID	County Code	UK Lab NO.
3/26/2008	SPRAY 2	49	219	65355

Nutrient	Lab Results	Level of Adequacy (Very Low / Low / Medium / High / Very High)	Calculated CEC Data
Phosphorus (P)	347	>>>	Soil pH is too high to calculate CEC. Calcium carbonate at high pH causes errors in the calculation.
Potassium (K)	448	>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>	
Soil pH	7.0		
Buffer pH	7.2		
Calcium (Ca)	4387		
Magnesium (Mg)	228	>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>	
Zinc (Zn)	12.1		
Other Test			

Acres	Primary Crop	Primary Management	Primary Use	Previous Crop	Previous Management	Previous Use	Crop 2 Years Ago Tobacco	Soil Drainage
	Wheat/Soybeans	No Tillage	Grain	Corn	No Tillage			

RECOMMENDATIONS:	N	P2O5	K2O	LIME	Mg	Zn
	see comments below	None	None	None	None	None

"ND BILL

COMMENTS:

Mehlich III used for P, K, Ca, Mg, and Zn (lbs/acre). Crop response is highly probable with Very Low or Low soil levels, slight with Medium, and not likely with High or Very High. N, P2O5, K2O, Mg, and Zn recommendations are based on lbs of the nutrient. Fertilizer needed will depend on nutrient content in the fertilizer. Soil pH and Sikora buffer pH are used for determining lime needs based on 100% effective lime. Lime quality in KY is defined by relative neutralizing value (RNV). RNV values for ag lime are determined by the KY Dept of Ag and are on the internet (publications at soils.rs.uky.edu).

FOR THE SMALL GRAIN CROP: FALL NITROGEN APPLICATION is not needed in fields following tobacco, soybeans, or well-fertilized corn or if litte growth of small grains is expected. For situations where little N carryover is expected, up to 40 lbs/acre of nitrogen is adequate for getting the small grain crop started. SPRING NITROGEN APPLICATION should be 60 to 90 lbs N/acre for a tilled seedbed or 90 to 120 lbs N/acre for a no-till seedbed. Application should occur between late February to early April. Where excessive rainfall occurs in late winter or early spring, split applications of nitrogen may be justified

FOR THE SOYBEAN CROP: No nitrogen is recommended in SPRING for soybeans.

Any P2O5 or K2O that is recommended can be applied in the fall before seeding the small grains as long as nitrogen application does not exceed 40 lb/ac. Small grains need very little nitrogen for fall growth.

It is not appropriate to calculate CEC at high pH where calcium carbonate can result in erroneously high calculated CEC.

Appendix E

Kentucky Phosphorus Index

The Phosphorus Index for the Cal-Maine Guthrie fields is determined based on these factors:

1. Cal-Maine fields predominantly consist of hydrologic soil drainage group B, based on the soil survey information.

2. Phosphorus soil test values are taken from the most recent annual soil tests. As long as the soil test values show phosphorus below 400 and no changes have been made in farming practices, the index should not change from year to year.

3. The soil survey information indicates an average field slope of about 5%.

4. Land cover of at least 40% is maintained on the fields at all times.

5. Cal-Maine will maintain a buffer strip at least 29 feet wide at the southern edge of the property upgradient of the blue-line stream, at the downstream edges of fields, and around sinkhole openings.

6. The Cal-Maine farm is not located in an impaired watershed area.

7. Land application at Cal-Maine is conducted from October through March, including application during the months of December and January.

8. The land-applied manure is incorporated within one month. The spray-applied wastewater is incorporated within 48 hours.

9. The nearest stream is more than 150 feet from Cal-Maine.

10. Cal-Maine is not in a bluegrass area.

In 2004, Kentucky P Index worksheets were completed for each type of field at the Cal-Maine Guthrie facility, with reference to the 2004 soil test phosphorus values: north and south fields used for land application of chicken manure, and north and south spray irrigation fields for wastewater. The Kentucky P Index worksheets indicate a medium risk for phosphorus movement from all fields at the Cal-Maine Guthrie farm.

The Kentucky Phosphorus Index will be recalculated each year if necessary, based on soil test values and on modifications in farming practices.

Kentucky Phosphorus Index

Multiplying the weighted factor by the value rating, yields points for that specific field feature.

Field Features (weighted factors in parenthesis below)	Field Feature Value Ratings			
	Low (1 point)	Medium (2 points)	High (4 points)	Very High (8 points)
1. *Hydrologic Soil Group (1.0)*	A	B	C	D
2. *Residual Soil Test (P) Level (3.0)*	Between 400-500	Between 501-800	Between 801-1066	Above 1066*
3. *Field Slope Percent (1.0)*	<2	2-5	6-12	>12
4. *Land Cover Percent* (3.0)* **estimated after application*	61-90	31-60	16-30	0-15
5. *Vegetative Buffer Width (3.0) (ft)*	>29	20-29	10-19	<10 or No Buffer
6. *Application Area Is In A Watershed Identified As Being Impaired Due To Agricultural Applied Nutrients (1.0))*	NO			YES
7. *Application Timing (3.0)*	June - Sept	April, May, Oct., March or Nov. w/ winter cover	March or Nov. w/o winter cover, Feb. w/ winter cover	Dec., Jan., Feb.
8. *Application Method (3.0)*	Injected	Surface applied and incorporated within 48 hr.	Surface applied and incorporated within 1 month	Surface applied and unincorporated for greater than 1 month
9. *Downstream Distance From Application Area To Spring, Stream or Waterbody (2.0)*	Over 150	51-150	0-50	Adjacent
10. *MLRA (County Location) (1.0)*	Bluegrass	All Other		

- ***Additional Phosphorus Will Not be Applied When Soil Test (P) Level is above 1066.***

Kentucky Phosphorus Index

Field	General Comments

KENTUCKY P INDEX WORKSHEET

Farm:	Cal-Maine Foods, Inc., Guthrie, Kentucky	Date: June 8, 2004
Tract:	Layer Farm, Fields used for application of chicken manure	

		FIELD FEATURE VALUE RATINGS (1, 2, 4, or 8 points)							
		Field #: North Acres: 76				Field #: South Acres: 82			
FIELD FEATURES	WEIGHTED FACTOR (WF)	Existing value	WF x Existing value	Planned value	WF x Planned value	Existing value	WF x Existing value	Planned value	WF x Planned value
1. *Hydrologic Soil Group*	1	2	2			2	2		
2. *Residual Soil Test (P)*	3	0	0			0	0		
3. *Field Slope Percent*	1	2	2			2	2		
4. *Land Cover Percent*	3	2	6			2	6		
5. *Vegetative Buffer Width*	3	1	3			1	3		
6. *Ag. Impaired Watershed*	1	1	1			1	1		
7. *Application Timing*	3	8	24			8	24		
8. *Application Method*	3	4	12			4	12		
9. *Distance To Waterbody*	2	1	2			1	2		
10. *MLRA Location*	1	2	2			2	2		
Field Features Index Totals		Existing Total*	***54***	**Planned Total**		Existing Total*	***54***	**Planned Total**	

*NOTE: If ***existing total*** results in a "Low" or "Medium" rating as indicated below, a nitrogen or phosphorus based nutrient management plan may be implemented.

Field Vulnerability for Phosphorus Loss	
Total Points from P Index	**Generalized Interpretation of P Index**
< 30	**LOW** potential for P movement from the field. Low probability of an adverse impact to waterbodies.
30 - 60	**MEDIUM** potential for P movement from the field. The chance of organic material and nutrients getting into waterbodies exists. Buffers, setbacks, lower manure rates, cover crops, crop residue practices alone or in combination may reduce impact.
61 - 112	**HIGH** potential for P movement from the field. The chance of organic material and nutrients getting to waterbodies is likely. Buffers, setbacks, lower manure rates, cover crops, crop residues, etc. in combination may reduce impact.
> 112	**VERY HIGH** potential for P movement from the field and an adverse impact on waterbodies.

NOTE: This worksheet is now available in an automated version. Contact NRCS offices for more information.

KENTUCKY P INDEX WORKSHEET

Farm:	Cal-Maine Foods, Inc., Guthrie, Kentucky	Date: June 8, 2004
Tract:	Layer Farm, Fields used for spray irrigation of wastewater	

		FIELD FEATURE VALUE RATINGS (1, 2, 4, or 8 points)							
		Field #: North Acres: 15				Field #: South Acres: 6			
FIELD FEATURES*	WEIGHTED FACTOR (WF)	Existing value	WF x Existing value	Planned value	WF x Planned value	Existing value	WF x Existing value	Planned value	WF x Planned value
1. *Hydrologic Soil Group*	1	2	2			2	2		
2. *Residual Soil Test (P)*	3	0	0			4	12		
3. *Field Slope Percent*	1	2	2			2	2		
4. *Land Cover Percent*	3	2	6			2	6		
5. *Vegetative Buffer Width*	3	1	3			1	3		
6. *Ag. Impaired Watershed*	1	1	1			1	1		
7. *Application Timing*	3	8	24			8	24		
8. *Application Method*	3	2	6			2	6		
9. *Distance To Waterbody*	2	1	2			1	2		
10. *MLRA Location*	1	2	2			2	2		
Field Features Index Totals		Existing Total*	***48***	Planned Total		Existing Total*	***60***	Planned Total	

*NOTE: If ***existing total*** results in a "Low" or "Medium" rating as indicated below, a nitrogen or phosphorus based nutrient management plan may be implemented.

Field Vulnerability for Phosphorus Loss	
Total Points from P Index	**Generalized Interpretation of P Index**
< 30	**LOW** potential for P movement from the field. Low probability of an adverse impact to waterbodies.
30 - 60	**MEDIUM** potential for P movement from the field. The chance of organic material and nutrients getting into waterbodies exists. Buffers, setbacks, lower manure rates, cover crops, crop residue practices alone or in combination may reduce impact.
61 - 112	**HIGH** potential for P movement from the field. The chance of organic material and nutrients getting to waterbodies is likely. Buffers, setbacks, lower manure rates, cover crops, crop residues, etc. in combination may reduce impact.
> 112	**VERY HIGH** potential for P movement from the field and an adverse impact on waterbodies.

NOTE: This worksheet is now available in an automated version. Contact NRCS offices for more information.

Appendix F

Crop Yields and Nutrient Removal Estimates

North Field, Layer Farm			
Crop	Corn	Wheat	Soybeans
Yield	145 bushels/acre	72 bushels/acre	38 bushels/acre
Estimated nutrient removal based on yield:			
Nitrogen	130 lbs/acre	90 lbs/acre	142 lbs/acre
P_2O_5	53 lbs/acre	62 lbs/acre	33 lbs/acre
K_2O	39 lbs/acre	27 lbs/acre	52 lbs/acre

Total acreage used for manure application in the North field: 75 acres

South Field, Layer Farm			
Crop	Corn	Wheat	Soybeans
Yield	155 bushels/acre	78 bushels/acre	42 bushels/acre
Estimated nutrient removal based on yield:			
Nitrogen	140 lbs/acre	98 lbs/acre	158 lbs/acre
P_2O_5	56 lbs/acre	66 lbs/acre	37 lbs/acre
K_2O	42 lbs/acre	29 lbs/acre	57 lbs/acre

Total acreage used for manure application in the South field: 80 acres

6/26/03

To: Ferlin Yoder

From: Marc Ashby

Ferlin: Please supply me with the following information as soon as possible so that I can update our Comprehensive Nutrient Mgmt. Plan. :

1) Total acreage cropped in **North field**: 76
2) Total Manure Application area(acreage) in **North field** (item #1 minus 50' setback along property lines, less 75' setback from sinkhole edges, less 75' setback along highway 181). 75
3) Total acreage cropped in **South field**: 82
4) Total Manure Application area(acreage) in **South field** (item #1 minus 50' setback along property lines, less 75' setback from sinkhole edges, less 75' setback along highway 181). 80
5) Average Yields In **North** Field:
   Corn 145 Beans 38 Wheat 72
6) Average Yields In **South** Field:
   Corn 155 Beans 42 Wheat 78
7) In the 4 year manure application rotation, when is the next year you'll apply manure to the **North** field? 2004
8) In the 4 year manure application rotation, when is the next year you'll apply manure to the **South** field? 2004

Ferlin, please get this back to me as soon as you can. Thanks, Marc

Estimated Crop Nutrient Removal Values according to NRCS's Agricultural Waste Management Field Handbook, Chapter 6.

CROP	Quantity	N	P2O5	K2O
Grain crops (bushels)				
Barley	50	44	19	12
1 T. straw	1	15	5	30
Corn	100	90	36	27
	120	108	43	32
	140	126	50	38
	160	144	58	43
	180	162	65	48
	200	180	72	54
	220	198	79	59
	240	216	87	65
	260	234	94	70
	280	252	101	75
	300	270	108	81
Oats	80	50	20	15
	90	56	23	17
2 T. straw	2	25	15	80
Rye	30	35	10	10
	40	47	13	13
	50	58	17	16
	60	70	20	20
	70	82	23	23
	80	93	27	26
	90	105	30	30
1.5 T. straw	1.5	15	8	25
Sorghum	60	56	28	17
	70	65	32	20
	80	75	37	23
	90	84	42	25
	100	94	46	28
	110	103	51	31
3 T. stover	3	65	21	94
Wheat	40	50	34	15
	50	62	43	19
	60	75	51	22
	70	87	60	26
	80	100	68	30
	90	112	77	34
	100	125	86	37
	110	137	94	41
1.5 T. straw	1.5	20	5	35
Oil crops (bushels or lbs)				
Rapeseed	35	63	32	16
3 T. straw	3	269	59	243
Soybeans	30	113	26	41
	40	150	35	55
	50	188	44	68
	60	225	53	82
	70	263	62	96
	80	300	71	109
	90	338	79	123
	100	375	88	137
Sunflower (lbs)	1100	39	43	15
Fiber crops (lbs of lint + lbs of seed)				
Cotton (600 lb lint per ac.)	1600	43	21	16
Cotton (700 lb lint per ac.)	1867	50	25	19
Cotton (800 lb lint per ac.)	2133	57	28	21
Cotton (900 lb lint per ac.)	2400	64	32	24
Cotton (1000 lb lint per ac.)	2667	71	36	27

CROP	Quantity	N	P2O5	K2O
Forage crops (tons)				
Alfalfa	4	180	40	180
	4.5	203	46	202
	5	225	51	224
	5.5	248	56	247
	6	270	61	269
	6.5	293	66	292
Big bluestem	3	59	117	126
	3.5	69	137	147
	4	79	156	168
	4.5	89	176	189
	5	99	196	210
Birdsfoot trefoil	3	149	30	131
Bluegrass-pastd.	2	116	40	94
Bromegrass	5	187	48	306
Clover-grass	6	182	75	243
Dallisgrass	3	115	28	124
Bermudagrass	8	301	70	269
	9	338	79	302
	10	376	87	336
	11	414	96	370
Indiangrass	3	60	117	86
Lespedeza	3	140	29	76
Little bluestem	3	66	117	104
	3.5	77	137	122
	4	88	156	139
	4.5	99	176	157
	5	110	196	174
Orchardgrass	6	176	55	311
Red clover	2.5	100	25	100
Reed Canarygrass	6.5	176	54	56
Ryegrass	3	100	37	102
	3.5	117	43	119
	4	134	50	136
	4.5	150	56	153
	5	167	62	170
Switchgrass	3	69	14	137
Tall fescue	3	118	28	144
	3.5	138	32	168
	4	158	37	192
	4.5	177	41	216
	5	197	46	240
Timothy	2.5	60	25	95
Wheatgrass	1	28	12	64
Silage crops (tons)				
Alfalfa haylage (50% dm)	10	279	76	278
Corn silage (35% dm)	20	154	81	183
Forage sorghum (30% dm)	20	173	52	147
Oat haylage (40% dm)	10	128	52	90
Sorghum-sudan (50% dm)	10	136	37	174
Tobacco (lbs)				
	2000	75	15	120
	2250	84	17	134
	2500	94	19	149
	2750	105	21	165
Turfgrasses (tons)				
Bluegrass	2	116	40	94
Bentgrass	2.5	155	47	133
Bermudagrass	4	150	35	134

Appendix G

Crop Nutrient Requirement Worksheets

Appendix G

Crop Nutrient Requirement Worksheets

Revised May 2008

Crop nutrient requirements are recalculated every year based on the soil test data, the most recent laboratory analysis of manure and wastewater samples, and modifications made in farming practices, if any.

The calculations for manure application indicate that a rate of two tons per year for the first crop rotation sequence, followed by three tons per year for the second two-year rotation, would be the optimum. However, the soil tests for the manure application fields do not indicate that phosphate concentrations are excessive. If Cal-Maine prefers to land-apply manure at a rate of three tons per acre in each field twice during the next four-year rotation; that would also be acceptable. The 2008 soil tests indicate that manure application to both the north and south fields will result in a nitrogen deficit over the next four years, so that supplemental nitrogen in the form of chemical fertilizer will be required. The calculations also indicate that a slight phosphorus overload is possible. Annual soil testing will be used to verify the calculated predications.

The 2008 calculations for spray irrigation are based on the assumption that both the north and south sprayfields will be in use during the next two years. Wastewater application was calculated assuming that all of the lagoon effluent would be applied to Sprayfield #2, and that approximately 1,000 gallons/day of the wastewater treatment plant effluent will be diverted to the lagoon and land-applied onto Sprayfield #2. The calculations indicate that this process will result in a more equitable distribution of nutrients between the two sprayfields and less likelihood of phosphate buildup in Sprayfield #1, and is the recommended procedure for this farm.

The calculations also indicate that supplemental nitrogen will be required on both sprayfields. Annual soil testing will be used to verify the calculated predications and to monitor the sprayfield phosphorus levels.

Cal-Maine Foods, Inc.
Guthrie, Kentucky

Crop Nutrient Requirements Worksheet: Wastewater Applied to North Sprayfield
Revised May 2008

				Nitrogen Removal	Phosphate Removal
1	Total crop nutrient requirement during 2-year rotation				
	Corn	(at 145 bu/ac)	lbs/acre	130	53
	Wheat	(at 72 bu/ac)	lbs/acre	90	62
	Soybeans	(at 38 bu/ac)	lbs/acre	142	33
	Total		lbs/acre	362	148
2	Nutrient value of wastewater plus rainwater in lagoon				
	Lab analysis, as N or P		mg/l	6.361	21.5
	Available, as N or P2O5		mg/l	3.1805	44.3
	Available, as N or P2O5		lbs/1,000 gal	0.027	0.370
3	Average wastewater flow	4,000	gallons/day	Based on inflow of 3,000 gallons per day plus an additional 1,000 gallons per day from the wastewater treatment plant	
4	2-year wastewater volume	2,920,000	gallons		
	2-year rain minus evaporation in lagoon	1,357,500	gallons	(based on 250' x 300' lagoon and rain minus evaporation of 15 inches per year)	
	2-year wastewater plus rain volume	4,277,500	gallons		
5	Acres available for irrigation	15.25			
6	Wastewater application in 2 years	280,492	gallons/acre		
7	Wastewater application rate	10.33	inches over the 2 year period		
8	**2-year nutrient loading**		**lbs/acre**	**7**	**104**
9	2-year nutrient uptake		lbs/acre	362	148
10	2-year nutrient deficit (-) or overload (+)		lbs/acre	-355	-44

Note: See Appendix H for recommendations on supplemental nitrogen, e.g., for irrigated corn, 175 to 200 lbs/acre nitrogen is recommended. Soil tests should determine actual nitrogen needs.

mg/l = milligrams per liter
lbs = pounds

Cal-Maine Foods, Inc.
Guthrie, Kentucky

Crop Nutrient Requirements Worksheet: Manure Applied to North Field

Revised May 2008

				Nitrogen	Phosphorus
1	Total crop nutrient requirement during 4-year rotation				
	Corn	(at 145 bu/ac)	lbs/acre	260	106
	Wheat	(at 72 bu/ac)	lbs/acre	180	124
	Soybeans	(at 38 bu/ac)	lbs/acre	284	66
	Total		lbs/acre	724	296
2	Nutrient value of manure				
	Lab analysis, as N or P2O5		lbs/ton	72.28	68.41
	Available, as N or P2O5		lbs/ton	36.14	61.6
3	Application rate		5.0 tons/acre		
4	Acres available for application		75		
5	Total manure to be applied		375 tons		
6	**4-year nutrient loading**		**lbs/acre**	**181**	**308**
7	4-year nutrient uptake		lbs/acre	724	296
8	4-year nutrient deficit (-) or overload (+)		lbs/acre	-543	12
9	Additional nitrogen required		lbs/acre	See Appendix H	
10	Additional phosphorus required		lbs/acre		None

Note: See recommendations for supplemental nitrogen in Appendix H, e.g., nitrogen recommended for corn in moderately well-drained soil is 165 to 200 lbs/acre for conservation tillage fields. Soil tests should determine actual nitrogen needs.

lbs = pounds

Cal-Maine Foods, Inc.
Guthrie, Kentucky

Crop Nutrient Requirements Worksheet: Manure Applied to South Field

Revised May 2008

				Nitrogen	Phosphorus
1	Total crop nutrient requirement during 4-year rotation				
	Corn	(at 155 bu/ac)	lbs/acre	280	112
	Wheat	(at 78 bu/ac)	lbs/acre	196	132
	Soybeans	(at 42 bu/ac)	lbs/acre	316	74
	Total		lbs/acre	792	318
2	Nutrient value of manure				
	Lab analysis, as N or P2O5		lbs/ton	72.28	68.41
	Available, as N or P2O5		lbs/ton	36.14	61.6
3	Application rate		5.0 tons/acre		
4	Acres available for application		80		
5	Total manure to be applied		400 tons		
6	**4-year nutrient loading**		**lbs/acre**	**181**	**308**
7	4-year nutrient uptake		lbs/acre	792	318
8	4-year nutrient deficit (-) or overload (+)		lbs/acre	-611	-10
9	Additional nitrogen required		lbs/acre	See Appendix H	
10	Additional phosphorus required		lbs/acre		None

Notes: See recommendations for supplemental nitrogen in Appendix H, e.g., nitrogen recommended for corn in moderately well-drained soil is 165 to 200 lbs/acre for conservation tillage fields. Soil tests should determine actual nitrogen needs.

lbs = pounds

Cal-Maine Foods, Inc.
Guthrie, Kentucky

Crop Nutrient Requirements Worksheet: Wastewater Applied to South Sprayfield
Revised May 2008

				Nitrogen Removal	Phosphate Removal
1	Total crop nutrient requirement during 2-year rotation				
	Corn	(at 145 bu/ac)	lbs/acre	130	53
	Wheat	(at 72 bu/ac)	lbs/acre	90	62
	Soybeans	(at 38 bu/ac)	lbs/acre	142	33
	Total		lbs/acre	362	148
2	Nutrient value of wastewater from treatment plant				
	Lab analysis, as N or P		mg/l	117.796	17.9
	Available, as N or P2O5		mg/l	58.898	36.9
	Available, as N or P2O5		lbs/1,000 gal	0.491	0.308
3	Average wastewater flow		3,000 gallons/day	Based on the assumption that 1,000 gallons per day will be diverted to the lagoon	
4	2-year wastewater volume		2,190,000 gallons		
5	Acres available for irrigation		6		
6	Wastewater application in 2 years		365,000 gallons/acre		
7	Wastewater application rate		13.44 inches over the 2 year period		
8	**2-year nutrient loading**		**lbs/acre**	**179**	**112**
9	2-year nutrient uptake		lbs/acre	362	148
10	2-year nutrient deficit (-) or overload (+)		lbs/acre	-183	-36

Note: See Appendix H for recommendations on supplemental nitrogen, e.g., for irrigated corn, 175 to 200 lbs/acre nitrogen is recommended. Soil tests should determine actual nitrogen needs.
lbs = pounds
bu/ac = bushels per acre

Appendix H

2004 - 2005 Lime and Fertilizer Recommendations

2004-2005 Lime and Nutrient Recommendations

Basis of Nutrient Recommendations

Additions of a recommended nutrient are based on a soil test only when a crop yield or economic response has been measured for that crop under Kentucky soil-climatic conditions. Many field studies have been conducted by the Kentucky Agricultural Experiment Station under Kentucky farm conditions to determine the extent of any primary, secondary, or micronutrient needs. Yield and soil test data from these studies serve as guidelines for establishing recommendations contained in this publication.

Nutrient recommendations in this publication are based on soil test values obtained using testing methods in the laboratories operated as part of the Kentucky Agricultural Experiment Station. This laboratory uses the Mehlich III solution to extract phosphorus (P), potassium (K), calcium (Ca), magnesium (Mg), and zinc (Zn). Water pH is determined in a 1:1 (v/v) ratio of deionized water:soil, and buffer pH is determined by a modification of the SMP (Shoemaker, McLean, and Pratt) method. These methods are described in Bulletin 190 of the Southern Cooperative Series (November 1984), *Procedures Used by the State Soil Testing Laboratories in the Southern Region of the United States.* The nutrient recommendations in this publication should not be used for soil test results obtained by other testing methods.

The recommendations are based on assumed average climatic and management conditions for Kentucky. Rates should be adjusted upward or downward to reflect any deviations from these assumptions.

The rates recommended are for production of a crop to be grown each year and will increase soil test values slowly for P and K. Using these recommended rates would likely take four years or longer of annual nutrient application at the recommended rates to result in appreciably higher soil test levels of P and K.

CEC and Percent Base Saturation

Values for cation exchange capacity (CEC) and percent base saturation (% BS) are reported for all soil samples analyzed routinely in the University of Kentucky Soil Testing Laboratories. The CEC is an estimate that is calculated according to accepted practices, with a modification to better reflect specific Kentucky conditions.

Reported values for CEC include an estimation of acidity (expressed as hydrogen, H) reflected by the buffer pH measurement and extractable calcium (Ca), magnesium (Mg), and potassium (K) by the Mehlich III extracting procedure. The total CEC is the sum of milliequivalents per 100 grams of soil (me./100 g) of the following cations: H, Ca, Mg, and K. Values for % BS are the sum of the me./100 g of the basic cations (Ca, Mg, and K) expressed as a percentage of the total CEC. The dominant cation in most Kentucky soils with pH above 5.8 is calcium (Ca), and below pH level 5.8 is hydrogen (H). Rarely does the amount of magnesium (Mg) or potassium (K) greatly affect CEC estimation or % BS. The measurements for Ca and H are the dominant values for estimating both CEC and % BS.

While CEC is not used directly in making nutrient recommendations for agronomic crops, this information does affect lime recommendations. The buffer pH is directly related to the acidity or H fraction of the CEC. Values for % BS are good indicators of the relative presence of the basic cations in the soil. Soils with a 70% BS or greater are unlikely to limit agronomic crop growth due to acidity. Agronomic crop yields on soils with a % BS below 50 can be affected by excessive acidity. Other Extension publications or your county Cooperative Extension Service agent should be consulted for soil pH of specific horticultural or agronomic crops for optimal growth and yield.

Sample Accuracy

It is important that the submitted soil sample accurately represent the field or area from which it was taken, in order to get reliable recommendations. Analytical results provided on the soil test report form are for the sample submitted, and the listed recommendations are based on those results. All recommendations are made on the assumption that a representative soil sample was properly taken. If soil sampling procedures are questionable, accurate nutrient and lime recommendations for the sampled field or area cannot be assured.

Sampling Depth and Frequency

For tilled areas, take soil cores to a depth of 6 to 7 inches. With pastures, lawns, no-tilled areas, and turf, take soil cores to a depth of 3 to 4 inches. Each production field should be sampled every three to four years. Annual sampling is preferable for high-value crops, alfalfa, and double-crop silage. Sampling each year after manure application is recommended. See Cooperative Extension Service publication *Taking Soil Test Samples* (AGR-16) for details.

Plant Analysis

A plant analysis may be used to verify a suspected nutrient problem or to evaluate the nutrient status of a crop. Plant analysis is not a substitute for a soil test but should be used along with a soil test. Your county Extension agent has information on plant analysis services available for various crops.

Fertilizer Banding

If soil tests for phosphorus and potassium are low, one-third to one-half the amount recommended for corn can be used if it is banded 2 to 4 inches from the row.

Soil Drainage Classes and Nitrogen Fertilization

Nitrogen fertilizer recommendations are related to soil drainage differences. Soils differ in water amounts entering and the percolation rate through the root zone. The list of important soil series below and their grouping into drainage classes do not always coincide with the NRCS/USDA drainage classes (indicated by an asterisk).

- **Well-Drained Soils**—Allegheny, Ashton, Baxter, Caneyville, Crider, Cuba, Elk, Frederick, Hagerstown, Huntington, Jefferson, Loradale, Maury, McAfee, Memphis, Nolin, Pembroke, Pope, Shelbyville, Shelocta, Trimble, Uniontown, Vicksburg, Wellston, Wheeling, Whitley.
- **Moderately Well-Drained Soils**—Beasley,* Bedford, Captina, Collins, Commerce, Cotaco, Eden,* Grenada, Heitt,* Loring, Lowell,* Mercer, Morehead, Mountview, Nicholson, Otwell, Sadler, Tilsit, Zanesville.
- **Somewhat Poorly and Poorly Drained Soils**—Belknap, Bonnie, Calloway, Falaya, Henry, Johnsburg, McGary, Melvin, Newark, Stendal, Tyler, Weinbach.

Soils with Naturally High Contents of P and K

Some soils naturally contain higher levels of P and K, thus having the ability to supply higher amounts for crop production. Soils developed from phosphatic limestones are likely to maintain high soil test P levels even without fertilization. Also, some soils will contain quite high native K levels.

Recommendations for Soil Samples Testing High

When soil test levels for P and K are so high that no nutrient recommendation is made for the current year, there is no assurance that these high levels will be maintained for optimal production in the following years. When soil test levels are in the upper one-half of the medium range or higher, the area should be sampled again the following year.

Nutrient Recommendations without Soil Tests

If nutrient recommendations must be made without soil test results, assume low levels of residual N, P, and K.

Nutrient Recommendations for Multiple Years

If one nutrient recommendation is made for two years of sequential crops, the recommended rates of phosphate and potash for each crop are added together and applied to the first crop grown. However, this method is not recommended for crops with a high nutrient demand, e.g., alfalfa, corn for silage, tobacco, etc. Double cropping recommendations for small grains and soybean can be found in the "Small Grains" and "Soybean" sections.

Surface Mine Reclamation

See Kentucky Cooperative Extension Service publications *Lime and Fertilizer Recommendations for Reclamation of Surface-Mined Coal Spoils* (AGR-40), *Sampling Surface Mine Lands before and after Mining* (AGR-41), and *Preparation of Surface-Mined Coal Spoils and Establishment of Vegetative Cover* (AGR-89).

Elemental and Oxide Values for P and K

Soil test values for phosphorus and potassium are reported as pounds per acre (lb/A) of elemental P and K. Nutrient recommendations are made on the oxide basis: lb. phosphate (P_2O_5) or potash (K_2O) per acre. Use the factors in Table 1 in converting.

Table 1. Converting elemental and oxide values.

To Convert		
From:	To:	Multiply By:
P_2O_5	P	0.44
P	P_2O_5	2.29
K_2O	K	0.83
K	K_2O	1.20

Nutrient Value of Manures and Tobacco Stalks

Animal manure and tobacco stalks add nutrients when applied to soils. These should be considered when deciding on materials to use in fulfilling crop nutrient recommendations. The best method to determine content of these materials is through sampling and testing. In cases where it is not possible to take samples in a timely manner, Table 2 can serve as a guide to estimate nutrients contained in the materials listed until samples can be obtained and tested.

It is important to remember when applying organic materials to soil that the nutrients they contain are not as available to the next crop as those nutrients contained in commercial fertilizers. While almost 100% of the potash is available, only about 80% of the phosphate is expected to be available to the next crop. Nitrogen availability is more variable, with its availability dependent on livestock species, how it is stored and handled, and when and how it is applied.

Animal manures also contain significant amounts of calcium, magnesium, sulfur, zinc, copper, and molybdenum that may be of value to crops. The added organic matter can also be of significant benefit to soils low in organic matter.

Extension publication *Using Animal Manures as Nutrient Sources* (AGR-146) and a computer spreadsheet are available through your county Cooperative Extension Service office to help determine application rates.

Tobacco stalks that are under a cover to prevent leaching of nutrients by rainfall are a significant source of nutrients. See Extension publication *Tobacco Stalks and Stems Fertility Value and Use* (AGR-23) for more information on the storage and use of tobacco stalks.

Table 2. Typical nitrogen, phosphate, and potash content of some manures and tobacco stalks.

Animal Manures*	% Water	N	P_2O_5	K_2O
Dairy cattle	80	11	9	12
Swine	80	9	9	8
Beef	80	11	7	10
Broiler litter	20	55	55	45
Broiler layers	40	35	55	30
Broiler pullets	30	40	45	40
Tobacco stalks	C	30	10	70

* Animal manures contain chloride, which can reduce the quality of tobacco. Limit rates to 10 tons per acre of cattle or swine manure. Poultry manure should not be applied to land in the year in which tobacco will be grown.

Secondary Nutrients and Micronutrients

Magnesium

Magnesium levels in soils range from very high (in loess-derived soils) to low (some sandstone-derived soils). Only limited crop yield responses have been observed for magnesium fertilization. It is sufficiently important in some areas and in determining CEC that a soil test be offered. Magnesium needs for animals can best be met by direct feeding in the ration rather than through high application rates to soil. Table 3 shows soil test levels and recommended rates for magnesium.

Table 3. Recommendations for magnesium.

Soil Test Level	Lb Mg/A*	Oz Mg/100 Sq Ft**
0 - 6	50	2
7 - 18	45	2
19 - 30	40	2
31 - 42	35	1
43 - 54	30	1
55 - 60	25	1
Above 60	0	0

* These rates may be applied when no lime is needed or where dolomitic lime is not available. When lime is needed, the addition of dolomitic lime is preferred.

** Epsom salts ($MgSO_4.7H_2O$, 10% Mg) is readily available and may be more convenient for applying Mg to small areas.

Iron, Copper, Sulfur, Boron, and Molybdenum

We have neither measured any response to nor observed indications of needs for additional iron, copper, or sulfur. Yield responses to boron and molybdenum have been observed for certain crops under certain conditions. Boron is recommended for topdressing on alfalfa. Consult the sections on tobacco, soybean, alfalfa, and pasture renovation with legumes for molybdenum recommendations.

Zinc and Manganese

Yield responses to zinc applications on corn and to foliar applications of manganese on soybean have been observed in Kentucky. The responses to manganese on soybean have been on a few soils in Daviess, McLean, and Webster counties. After diagnosis of manganese deficiency, responses to foliar applications have been superior to soil-applied manganese at planting. To date, soil testing has not been advantageous in solving any isolated cases in Kentucky soils.

Zinc deficiency in corn is significant in Central and South-Central Kentucky. A soil test for zinc is performed routinely on all samples submitted to the UK Soil Testing Lab. The zinc test results and soil test results for P and soil pH are used in identifying soils that need zinc applications.

Nutrients Removed by Agronomic Crops

Good nutrient management involves effective use of applied nutrients at rates utilized by crops. As a basis to assess long-term soil fertility trends, some may use crop nutrient removal while others may use crop uptake. Crop nutrient removal is the quantity of nutrients removed from a field in the harvested portion of the crop. This should not be confused with crop nutrient uptake values, which are the total amount of nutrients taken up by the entire crop (roots, stems, leaves, and seed) in a field. For quick reference, Table 4 includes crop nutrient removal values, published in Extension publication *Assessment of the Potential for Livestock and Poultry Manure to Provide the Nutrients Removed by Crops and Forages in Kentucky* (IP-56) and in "NRCS Nutrient Management Standard Code 590."

Table 4. Crop nutrient removal values.

Crop	Yield Unit	Nutrients Removed N	P_2O_5	K_2O
from IP-56:		**lb/yield unit**		
Alfalfa hay	ton	50.00	14.000	55.000
Grass/legume hay	ton	35.00	12.000	53.000
Pasture forage	ton	10.50	3.600	15.900
Corn for grain	bu	0.70	0.400	0.350
Silage corn	ton	7.50	3.500	8.000
Wheat grain	bu	1.20	0.500	0.300
Sorghum grain	bu	0.95	0.410	0.300
Soybean grain	bu	3.00	0.700	1.100
Burley tobacco	lb	0.07	0.011	0.075
Dark air tobacco	lb	0.07	0.006	0.060
Dark fired tobacco	lb	0.07	0.006	0.060
Barley grain	bu	0.90	0.410	0.300
from NRCS Code 590:		**lb/yield unit**		
Rye grain	bu	1.16	0.330	0.320
Oats grain	bu	0.62	0.250	0.190
Bermuda grass hay	ton	37.60	8.700	33.600
Reed canary hay	ton	27.00	8.200	25.000
Eastern gamma hay	ton	35.00	16.100	31.200
Other warm-season hay	ton	20.00	6.800	25.000

Soil Buffer Test

The pH of the soil is a measurement made from a mixture of soil and water and is reported for all samples. The soil buffer test is performed and used to determine lime requirement of samples with a soil pH of 6.4 or below. In the soil buffer test, a buffer solution is mixed with soil, and the pH of the mixed solution is measured. The result from the buffer test is reported as buffer pH. The buffer pH and the soil pH together can be used to determine lime requirement for changing soil pH to some desired level. Buffer pH is not the same as soil pH.

To determine how much lime is required to raise soil-water pH, refer to the table with your target pH in the heading. Tables 5, 6, and 7 show target soil-water pH of 6.4, 6.6, and 6.8, respectively. Amounts of limestone per acre are given for water pH vs. buffer pH in increments of 0.2 pH units. (Computerized recommendations use 0.1 pH unit increments.) To determine

limestone rates, read down the left side of the appropriate table to the water pH reading, then read across to the column under the buffer pH reading. If hydrated lime is applied, use two-thirds of the rate shown.

The adjustment of soil pH by limestone is affected by (1) thoroughness of mixing into the soil; (2) depth of mixing into soil (top 6 inches is assumed); (3) time of reaction (four years are needed for complete reaction of limestone; however, the reaction time for hydrated lime is much shorter); (4) quality of limestone (a relative neutralizing value of 67% is assumed); and (5) use of acid-forming nitrogen fertilizers that can lower the effective soil pH obtained. When applying lime rates greater than 4 tons per acre (T/A), the lime should be thoroughly mixed in the plow layer by applying one-half the recommended rate before plowing and the other half after plowing followed by discing. Consult *Determining the Quality of Aglime: Relative Neutralizing Value (RNV)* (AGR-106) and your county Extension agent for lime quality information in your area.

Table 5. Rate of agricultural limestone (T/A) needed to raise soil pH to 6.4.

Water pH of Sample	Buffer pH of Sample								If Buffer pH Is Unknown
	5.5	5.7	5.9	6.1	6.3	6.5	6.7	6.9	
4.5	7.0	6.0	6.0	5.0	4.0	4.0	3.0	3.0	4.0
4.7	7.0	6.0	6.0	5.0	4.0	4.0	3.0	3.0	4.0
4.9	7.0	6.0	6.0	5.0	4.0	4.0	3.0	3.0	4.0
5.1	7.0	6.0	5.0	5.0	4.0	3.0	3.0	2.0	4.0
5.3	7.0	6.0	5.0	4.0	4.0	3.0	3.0	2.0	3.5
5.5	6.0	5.0	5.0	4.0	4.0	3.0	2.0	2.0	3.0
5.7	6.0	5.0	4.0	4.0	3.0	3.0	2.0	2.0	2.5
5.9	—	5.0	4.0	3.0	3.0	2.0	2.0	1.0	2.0
6.1	—	—	3.0	3.0	2.0	2.0	1.0	1.0	1.5

Table 6. Rate of agricultural limestone (T/A) needed to raise soil pH to 6.6.

Water pH of Sample	Buffer pH of Sample								If Buffer pH Is Unknown
	5.5	5.7	5.9	6.1	6.3	6.5	6.7	6.9	
4.5	7.0	7.0	6.0	6.0	5.0	4.0	4.0	3.0	6.0
4.7	7.0	7.0	6.0	6.0	5.0	4.0	4.0	3.0	5.5
4.9	7.0	7.0	6.0	6.0	5.0	4.0	4.0	3.0	5.0
5.1	7.0	7.0	6.0	5.0	4.0	4.0	4.0	3.0	4.5
5.3	7.0	7.0	6.0	5.0	4.0	4.0	3.0	2.0	4.0
5.5	7.0	6.0	5.0	5.0	4.0	3.0	3.0	2.0	3.5
5.7	6.0	6.0	5.0	4.0	4.0	3.0	2.0	2.0	3.0
5.9	—	5.0	4.0	4.0	3.0	3.0	2.0	2.0	2.5
6.1	—	—	4.0	3.0	3.0	2.0	2.0	1.0	2.0
6.3	—	—	—	3.0	2.0	2.0	1.0	1.0	1.5

Table 7. Rate of agricultural limestone (T/A) needed to raise soil pH to 6.8.

Water pH of Sample	Buffer pH of Sample								If Buffer pH Is Unknown
	5.5	5.7	5.9	6.1	6.3	6.5	6.7	6.9	
4.5	7.0	7.0	7.0	6.0	5.0	5.0	4.0	3.0	6.0
4.7	7.0	7.0	7.0	6.0	5.0	5.0	4.0	3.0	6.0
4.9	7.0	7.0	7.0	6.0	5.0	5.0	4.0	3.0	6.0
5.1	7.0	7.0	7.0	6.0	5.0	5.0	4.0	3.0	6.0
5.3	7.0	7.0	7.0	6.0	5.0	4.0	3.0	3.0	5.5
5.5	7.0	7.0	6.0	5.0	5.0	4.0	3.0	3.0	5.0
5.7	7.0	7.0	6.0	5.0	5.0	4.0	3.0	2.0	4.5
5.9	—	6.0	5.0	5.0	4.0	4.0	3.0	2.0	3.5
6.1	—	—	5.0	4.0	4.0	3.0	2.0	2.0	3.0
6.3	—	—	—	3.0	3.0	3.0	2.0	1.0	2.5
6.5	—	—	—	—	2.0	2.0	2.0	1.0	2.0

Corn

Lime

If water pH is below 6.2, refer to page 6 and use the appropriate amount for a target pH of 6.4.

Nitrogen

Also see the "Fertility Management" chapter in Cooperative Extension Service publication *A Comprehensive Guide to Corn Management* (ID-139).

Table 13. Recommended application of nitrogen, lb/A. (See adjustments below). *Corn*

	Intensive Tillage[1]			Conservation Tillage[1]	
Previous Crop	Well-Drained Soils[2]	Moderately Well-Drained Soils[2]	Poorly Drained Soils[2]	Well-Drained Soils[2]	Moderately Well-Drained to Poorly Drained Soils[2]
Corn, sorghum, soybean, small grain, fallow	100-140	140-175	175-200	125-165	165-200
Grass, grass-legume sod (4 yr or less), winter annual legume cover	75-115	115-150	150-175	100-140	140-175
Grass, grass-legume sod (5 yr or more)	50-90	90-125	125-150	75-115	115-150

[1] Intensive tillage has less than 30% residue cover, and conservation tillage has more than 30% residue cover on the soil at planting.
[2] Soil drainage class examples are given on page 4.

Adjustments to Recommendations in Table 13:

- **Irrigation**—Nitrogen rate on irrigated corn should be increased to 175-200 lb N/A due to increased risk of depletion of available N from crop uptake, leaching, and denitrification.
- **Sidedressed N**—On moderately well-drained to poorly drained soil, rates of nitrogen can be decreased by 35 lb/A if as much as two-thirds of the N is applied four to six weeks after planting.
- **Conservation Tillage**—On moderately well-drained to poorly drained soils, the risk of denitrification loss is great from N applied at or near planting on conservation-till corn. Alternative practices may include: 1) split N application as noted in comment above; 2) use of maximum rate in appropriate recommended range at planting; or 3) use of a nitrification inhibitor at planting with N sources that include urea, N-solutions, or anhydrous ammonia with minimum rate in the appropriate recommended range.
- **Surface-Applied Urea**—Volatilization losses of N from urea-based products can be significant with surface application after May 1. Alternative practices include: 1) irrigation or incorporation within two days after application; 2) use of a urease inhibitor; 3) use of maximum rate in appropriate recommended range.

Winter Legume Cover Crops—A winter legume cover crop can provide a substantial amount of nitrogen for corn with either no-tillage or conventional tillage. Research conducted by the University of Kentucky on no-tillage corn indicates that some legume cover crops can provide yield advantages beyond that provided by fertilizer nitrogen. Hairy vetch performed better than crimson clover or big flower vetch. The dense mulch resulting from a killed legume cover crop conserves soil water, aids in weed control, and helps to control soil erosion.

Three important factors should be considered when using a legume cover crop:

1. The amount of nitrogen provided will depend on the amount of growth the legume makes before it is chemically killed or plowed under. However, corn planting should not be delayed later than mid-May, particularly in well-drained soils.
2. A cover crop, legume or nonlegume, can deplete soil water during a dry spring, resulting in decreased germination and seedling growth of corn.
3. Some vetch seeds are hard and can remain in the soil for one or more years before germinating. The result can be volunteer vetch in small grains grown in rotation with corn unless the vetch is killed with herbicides in the early spring.

Placement—Small amounts of N plus K_2O can be applied in the row, but if more than 15 lb/A of N plus K_2O is banded, it should be banded at least 2 inches below the soil surface and 2 inches to the side of the row center. No more than 100 lb/A of N plus K_2O should be banded near the row. Fertilizer for banding near or in the row should not contain urea.

Table 14. Phosphate recommendations. *Corn*

Category	Lb/A Soil Test P	Lb/A P_2O_5 to Apply
High	above 60	0
Medium	46 - 60	30
	41 - 45	40
	37 - 40	50
	33 - 36	60
	28 - 32	70
Low	23 - 27	80
	19 - 22	90
	14 - 18	100
	9 - 13	110
	6 - 8	120
Very low	1 - 5	200

Table 15. Potash recommendations. *Corn*

Category	Lb/A Soil Test K	Grain Lb/A K_2O to Apply	Silage Lb/A K_2O to Apply
Very high	Above 420	0	0
High	355 - 420	0	30
	336 - 354	0	40
	318 - 335	0	50
	301 - 317	0	60
Medium	282 - 300	30	70
	264 - 281	30	80
	242 - 263	30	90
	226 - 241	40	100
	209 - 225	50	110
	191 - 208	60	120
Low	173 - 190	70	130
	155 - 172	80	140
	136 - 154	90	150
	118 - 135	100	160
	100 - 117	110	170
Very low	Below 100	120	180

Zinc

Where zinc deficiency of corn is suspected or has previously occurred, a zinc soil test is helpful in determining if zinc should be applied. The following table lists soil test zinc levels at various soil pH ranges and soil test P levels below which a response to zinc fertilization is likely to occur. However, many other factors including weather conditions and cool soil temperatures affect availability of soil zinc to corn, making it difficult to predict a response to added zinc for a specific growing season. Zinc can be applied as a broadcast or band treatment. The broadcast treatment should raise the Zn soil test to acceptable levels for several years.

Table 16. Zinc soil test levels required for Zn recommendations.[1] *Corn*

Soil Test P	Soil Water pH																	Zn Recommended (Lb/A)	
Lb/A	6.0	6.1	6.2	6.3	6.4	6.5	6.6	6.7	6.8	6.9	7.0	7.1	7.2	7.3	7.4	7.5	7.6	Broadcast	Banded
25	0.5	0.7	0.9	1.0	1.2	1.4	1.6	1.7	1.9	2.1	2.3	2.4	2.6	2.8	3.0	3.1	3.3		
50	1.1	1.2	1.4	1.6	1.8	1.9	2.1	2.3	2.5	2.6	2.8	3.0	3.2	3.3	3.5	3.7	3.9		
75	1.4	1.5	1.7	1.9	2.1	2.2	2.4	2.6	2.8	3.0	3.1	3.3	3.5	3.6	3.8	4.0	4.2	10-15	2-3
100	1.6	1.8	1.9	2.1	2.3	2.5	2.6	2.8	3.0	3.2	3.4	3.5	3.7	3.9	4.1	4.2	4.4		
150	1.9	2.1	2.3	2.4	2.6	2.8	3.0	3.1	3.3	3.5	3.7	3.8	4.0	4.2	4.4	4.5	4.7		
200	2.1	2.3	2.5	2.7	2.8	3.0	3.2	3.4	3.5	3.7	3.9	4.1	4.2	4.4	4.6	4.8	4.9		
250	2.3	2.5	2.7	2.8	3.0	3.2	3.4	3.5	3.7	3.9	4.1	4.2	4.4	4.6	4.8	4.9	5.1		
300	2.4	2.6	2.8	3.0	3.2	3.3	3.5	3.7	3.9	4.0	4.2	4.4	4.6	4.7	4.9	5.1	5.3		
350	2.6	2.7	2.9	3.1	3.3	3.4	3.6	3.8	4.0	4.2	4.3	4.5	4.7	4.9	5.0	5.2	5.4	20-30	4-6
400	2.7	2.9	3.0	3.2	3.4	3.6	3.7	3.9	4.1	4.3	4.4	4.6	4.8	5.0	5.1	5.3	5.5		
450	2.8	2.9	3.1	3.3	3.5	3.6	3.8	4.0	4.2	4.3	4.5	4.7	4.9	5.1	5.2	5.4	5.6		
500	2.8	3.0	3.2	3.4	3.6	3.7	3.9	4.1	4.3	4.4	4.6	4.8	5.0	5.1	5.3	5.5	5.7		

[1] Zinc and phosphorus levels shown are from soil extraction by the Mehlich III procedure. To determine if zinc is needed, find the appropriate soil test P level in the left column and read across the table to the appropriate soil pH level. If soil test zinc is less than that shown for the appropriate soil test P level and pH, apply fertilizer zinc as recommended in the table.

Soybean

Lime

If water pH is below 6.2, refer to page 6 and use the appropriate amount for a target pH of 6.4.

Nitrogen

No nitrogen is recommended for well-nodulated soybean.

Table 17. Phosphate recommendations. *Soybean*

Category	Lb/A Soil Test P	Lb/A P_2O_5 to Apply
High	above 60	0
Medium	40 - 60	30
	34 - 39	40
	28 - 33	50
Low	22 - 27	60
	16 - 21	70
	11 - 15	80
	9 - 10	90
	7 - 8	100
	6	110
Very low	1 - 5	120

Table 18. Potash recommendations. *Soybean*

Category	Lb/A Soil Test K	Lb/A K_2O to Apply
High	above 300	0
Medium	242 - 300	30
	226 - 241	40
	209 - 225	50
	191 - 208	60
Low	173 - 190	70
	155 - 172	80
	136 - 154	90
	118 - 135	100
	100 - 117	110
Very low	82 - 99	120
	64 - 81	130
	46 - 63	140
	below 46	150

Double Cropping of Small Grains and Soybean—The phosphate recommendation should be taken from small grains, and the potash recommendation should be taken from soybean. This recommendation can be applied in the fall before seeding the small grain.

Inoculation

Soybean should be inoculated when planted in fields where soybean has not been grown in the past three to five years, or where previously grown soybean had few nodules. If inoculation is necessary, the inoculant should be applied to the seed or in the row at planting. Delays in planting inoculated seed often result in poor nodulation. Numbers of live rhizobia in inoculum decrease rapidly under dry conditions, exposure to sunlight and high temperatures, or when packaged dry with sodium molybdate and fungicides.

Molybdenum

If soils are limed to maintain pH values at 6.2 or above, aluminum and manganese toxicities and molybdenum deficiency usually do not occur in soybean. However, in soils with pH values below 6.2 at seeding time, molybdenum application to soybean is recommended. Apply 1 to 2 oz of sodium molybdate (0.4 to 0.8 oz of elemental molybdenum) per acre as a seed treatment. This is a satisfactory method of applying a small amount of molybdenum where no seed inoculant is needed. Where soybean seed is to be inoculated, including sodium molybdate with the inoculum may seriously lower the numbers of live rhizobia if not planted immediately. If both inoculum and molybdenum are needed, apply inoculum to the seed and broadcast the molybdenum on the soil. For each acre, dissolve 1 lb sodium molybdate (6.4 oz molybdenum) in 20 to 40 gallons of water and spray uniformly ahead of final seedbed preparation. Not more than 2 lb sodium molybdate (13 oz molybdenum) per acre should be used during any five-year period. Use of molybdenum should not be substituted for a good liming program.

Manganese

Foliar applications of manganese on manganese-deficient soybean have been superior to soil applications made at planting. Foliar manganese spray is recommended in two forms: chelated manganese at rates recommended by the manufacturer on the label, and manganese sulfate at the rate of 1.0 to 1.5 lb of actual manganese per acre in 20 to 25 gallons of water when the soybean is 10 inches high or higher.

Small Grains

(Barley, Oats, Rye, Wheat, and Triticale)

Lime

If water pH is below 6.2, refer to page 6, and use the appropriate amount for a target pH of 6.4.

Nitrogen

Fall Application—Only enough N to provide for good ground cover and to stimulate tillering is necessary. Seedings following tobacco, soybean, or well-fertilized corn will likely have enough carryover N for fall growth. For optimal fertilizer N efficiency, the total fall application should not exceed 40 lb N/A for seedings in fields with insufficient N carryover. Fall-applied N will be of little benefit where little fall growth is expected.

Spring Application—Application from late February to early April is the most effective. Where excessive rainfall occurs in late winter or early spring, split applications of spring-applied N may be justified.

Table 19. Spring nitrogen rates. *Small Grains*

	Lb N/A
Tilled seedbed	60 - 90
No-till seedbed	90 - 120

Sources—Experimental results have shown little difference among nitrogen materials commonly used to supply supplemental N to small grains.

Small Grains for Grazing—Total forage production from small grains can be increased by splitting nitrogen applications between fall and spring. For fall grazing, apply 50 to 60 lb N/A at seeding. A late winter or early spring topdressing of 30 to 50 lb N/A will stimulate early growth for additional grazing.

Intensively Managed Wheat—When managed for high yields (70 to 100 bu/A), wheat should receive higher rates of N in the spring. If spring N is split into two applications (early to mid-February and mid- to late March), yields will be 3 to 5 bu/A higher than if all N is applied in a single application in mid- to late March. The February application should be made at "green-up," and the March application should be made at Feek's growth stage 5 or 6 (just prior to jointing or at jointing). "Green-up" may not occur until March in Central and Northern Kentucky.

Double Cropping of Small Grains and Soybean—The phosphate recommendation should be taken from small grains, and the potash recommendation should be taken from soybean. This recommendation can be applied in the fall before seeding the small grain.

Small Grains for Silage—Small grains harvested for silage remove large amounts of potash from the soil. When double cropping small grains with corn or soybean where the small grain is to be cut for silage, apply recommended rates of potash for small grain at the time of seeding and for corn or soybean at the time of its seeding.

Table 20. Spring nitrogen rates (lb/A). *Intensive Wheat*

	February	March	Total
Single application	0	95	95
Split application	30 - 60	75 - 45	105

Table 21. Phosphate recommendations. *Small Grains*

Category	Lb/A Soil Test P	Lb/A P_2O_5 to Apply
High	above 60	0
Medium	48 - 60	30
	45 - 47	40
	41 - 44	50
	38 - 40	60
	34 - 37	70
	31 - 33	80
Low	24 - 30	90
	17 - 23	100
	10 - 16	110
Very low	below 10	120

Table 22. Potash recommendations. *Small Grains*

Category	Lb/A Soil Test K	Lb/A K_2O to Apply
High	above 300	0
Medium	213 - 300	30
	187 - 212	40
Low	159 - 186	50
	132 - 158	60
	104 - 131	70
Very low	below 104	80